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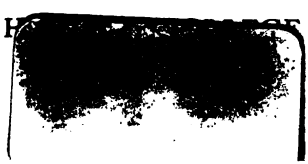

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TYPE STUDIES

FROM

THE GEOGRAPHY OF THE UNITED STATES

The MMCo.

Physiographic map of the United States, giving the names of the principal mountains, plateaus, and plains.

TYPE STUDIES

FROM

THE GEOGRAPHY OF THE UNITED STATES

FIRST SERIES

BY

CHARLES A. McMURRY, PH.D.

New York
THE MACMILLAN COMPANY
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PREFACE

THE series of twenty-five type studies included in this volume is designed to illustrate in some detail the second stage of geography study. The previous volume of "Excursions and Lessons in Home Geography" contains the introductory lessons in geography for third and fourth grades. It is the geography of the home and neighborhood.

The present volume is a series of simple type studies on the United States, designed to introduce children to the geography of our own country. It is assumed that the chief stress in early years (fourth, fifth, and sixth grades) should be laid upon American geography, though other countries are not neglected. Where a standard geography is used, these type studies may be run parallel with the regular lessons to enrich special and important topics.

The full oral treatment of these topics in the latter part of the fourth grade and in the fifth grade is probably the best method of handling them wherever this is possible.

The value of the type in its rich descriptive content and as a striking representative of many similar objects is abundantly illustrated in these lessons.

The organization of a large body of interesting and instructive geographical facts about such a centre of study exemplifies one of the chief points in method.

Nearly all the lessons included in this volume have been repeatedly worked out with classes of children in fourth and fifth grades.

The "Special Method in Geography," published by The Macmillan Company, works out the full course of study in geography in all the grades and discusses at length the method of treating these types. The present volume is the execution in its details of the second step in the general plan laid out in the "Special Method." In the further execution of this plan, the author contemplates another series of type studies of North America, which will deal with the more complex and difficult topics of our own continent. This will include the more comprehensive physiographic topics, the larger manufacturing and commercial subjects, and some of the large cities as centres of population and trade.

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TYPE STUDIES FROM THE GEOGRAPHY OF THE UNITED STATES

THE HUDSON RIVER

THE Hudson River springs from the steep, rocky, mountain slopes of the Adirondacks, dark with pine woods, and finds its mouth at New York Bay and the Narrows, just below the end of Manhattan Island. This river is so broad and deep just west of New York city that it has never been bridged. In fact, there is no bridge across the river till one gets beyond West Point in the Highlands. Ever since the days when Henry Hudson and his crew on the *Half Moon* sailed up this broad stream, it has been one of the most interesting of American rivers to the traveller.

The waters of the Hudson fill a great, trough-like valley about 150 miles long. And yet it is not wholly the waters of the river, for the salt waters of the ocean have poured in with its rising tides and helped to fill up this trough. The whole trough of the Hudson used to lie above the level of the sea, and in those days a small, shallow river flowed down past Manhattan, but for some cause the land sank down till the great valley was somewhat below the sea-level, and now the tides

from the ocean reach as far as Albany. The trough of the Hudson is called a drowned valley, and it might be called an arm of the sea, as Henry Hudson thought it was when he first sailed up its channel for many miles, hoping to find an outlet to another ocean to the north or west.

Unlike most rivers, the banks of the Hudson are interesting to the traveller down to its very mouth at New

FIG. 1.

The drowned valley of the Hudson, looking north from West Point.

York city. Even Manhattan Island consists partly of rock ridges rising two hundred feet above the Hudson. For nearly sixty miles just above New York, the river passes through a rugged and even mountainous region. In the neighborhood of West Point the river has cut its way through a range of mountains called the Highlands, which stretched directly across its path. The deep, nar-

row gorge which the river has carved out through these rugged mountains displays the most interesting scenery of the river. The national military academy of West Point lies like a nest two hundred feet above the river, in the very centre of this mountain scenery.

North of the Highlands the banks of the Hudson are flattened out into a broader valley. Twelve miles to the

FIG. 2.

A view in New York harbor, showing the vessels coming and going.

west are seen the blue ridges of the Catskills, with their deep valleys, summer hotels, and broad mountain views. They are a much visited summer resort.

From the deck of one of the Hudson River steamers one may get the best views of the changing scenery in passing northward. In the summer and autumn these steamers leave the New York wharf daily at eight forty-five in the morning, and reach Albany at six in the evening. This gives a nine hours' trip well filled with beautiful scenery. At New York city the Hudson River

is enlivened with ships and boats of all descriptions, from a rowboat to an ocean liner. On both sides of the river are miles of docks and piers of the great ship companies, and the lofty buildings of lower New York tower far above the older buildings.

Before leaving the shores of Manhattan Island, we see the steep black rocks of the Palisades, stretching like a mighty wall along the western shore, with scarcely room enough at their base for a house or factory. For fifteen miles they stand along the river's side almost unbroken, crowned with forests at the top, and rising more than three hundred feet abruptly from the river.

On the east side above Yonkers, on the wooded slopes and hilltops, are seen some of the villas and country homes of wealthy New York families. Nearer the shore, but hidden by the bushes and trees, is Sunnyside, where Irving lived, and, a little farther on, Tarrytown and Sleepy Hollow, famous in connection with Irving's life and writings. The widening of the river at Tappan Bay and Haverstraw Bay gives it the appearance of a placid lake at one place four miles across, and from the sloping hillsides many beautiful villas look down upon these broad stretches of the Hudson.

Passing into the Highlands, the stream narrows, as its waters have found it difficult to cut their way through the hard rock of the mountain roots which close in upon it along this rocky gorge.

A visit to West Point, by climbing the well-built road which winds up to the level plateau, is well worth our time. Many famous generals of the Mexican and Civil wars received here their military training. The trophies of old guns and weapons of war in the museum are of curious interest.

The broad parade grounds, where the young soldiers are drilled, are surrounded by pleasant shaded walks.

Four hundred feet higher up the hillside is Fort Putnam, from which may be had a broad survey of the river and mountains. Below the grounds, along the wooded slopes, one may climb down to the rocky spurs of the mountains, which dip their barren sides into the river.

The view northward from West Point, perhaps the most beautiful on the river, stretches away between mountains that rise from twelve to sixteen hundred feet above the stream.

During the Revolution the guns of this strongly fortified position, commanding the narrows below, kept the control of the river for the Americans.

After coming out of the Highlands, the great passenger steamer passes under the high railroad bridge at Poughkeepsie. This city of twenty-five thousand people lies on a plain some two hundred feet above the river, with a background of hills much higher. Vassar College, a famous school for women, and several other schools, are here.

FIG. 3.
Railway bridge across the Hudson at Poughkeepsie.

West of the Hudson the Catskill Mountains come in view, but the rest of the journey to Albany is less interesting from a scenic point of view.

Besides the great passenger steamers which make their trips each day and night up and down the river, we notice a great amount of heavy freighting on canal-boats and barges and freight steamers. A tugboat or steamer is seen trailing a whole fleet of heavy-laden canal-boats down the river.

FIG. 4.

The forest-covered slopes of the Adirondacks, with a beautiful lake nestled in the midst of the forest. (Copyrighted, 1888, by S. R. Stoddard, Glens Falls, N.Y.)

Barges loaded with brick or stone are constantly sent down the stream to New York. All along the valley of the lower Hudson are extensive clay beds of excellent quality for brick making. At various points along the shores one sees immense brick-yards. By means of the river barges these bricks can be easily and cheaply sent to

New York, where they are used in vast quantities. The valley of the Hudson is said to be the largest brick manufacturing district in the world. From the stone quarries along the river are also obtained great quantities of flagstone for pavements in New York and neighboring cities; also crushed stone, cement, and lime. There are five hundred stone quarries in one county near the banks of the Hudson. All the cities and towns along the Hudson are centres of important manufacturing, and this calls for the shipment of many raw materials by boat up and down the river, such as coal, lumber, iron, and grain.

On both sides of the Hudson River are double-track railroads, the New York Central on the east and the West Shore on the west, which do a very heavy freight and passenger traffic. In a number of places on both sides, the railroads pass through long tunnels cut through the rocky cliffs projecting into the river. Anthony's Nose, on the east side, is thus pierced by a tunnel, and another passes under the plateau upon which West Point stands. The railroad traffic along this valley is very extensive. A good part of the ice used in New York city comes from the ice-houses along the valley sides. A large proportion also of the milk and vegetables for the great cities is shipped from the farms and gardens bordering on the Hudson.

From the above description, it is clear that the Hudson Valley is a very important traffic route both by water and by rail. The chief importance, however, of the valley of the Hudson is not seen in these things, but by a broader survey of the connections of this valley with western New York and the Great Lakes, and with Lake Champlain. From Albany, the head of navigation on the Hudson, a canal is carried to the foot of Lake Champlain. This is

an easy means of transport for the lumber, stone, iron ore, and slate from the Adirondacks, Vermont, and Canada. One of the largest lumber-yards in the United States is at Albany, where this canal connects with the Hudson.

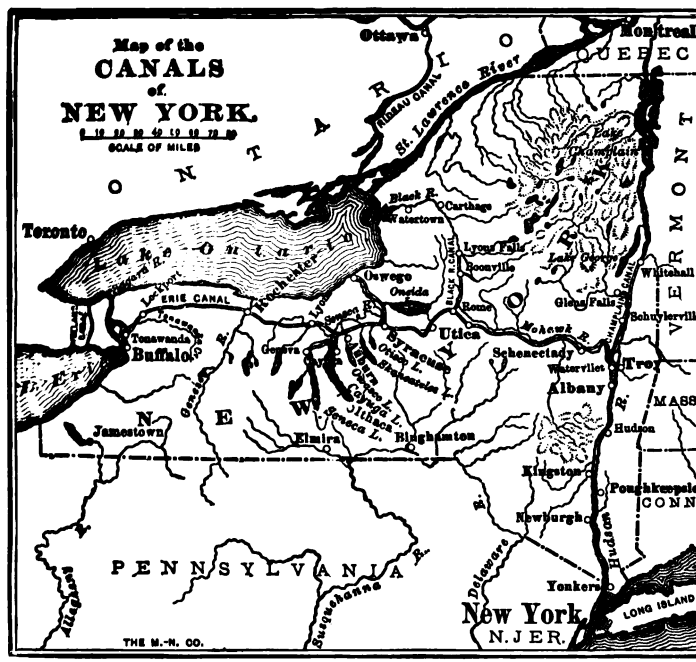


FIG. 5.

The Erie Canal and other water routes of New York and vicinity.

From Albany along the valley of the Mohawk across the plain of northern New York to Buffalo extends the famous Erie Canal. It is 363 miles long and cost nearly $10,000,000 when first built, but much more has been spent upon it since. The great amount of money spent upon

this canal, and the trunk railroad lines which run parallel to it, explain to some extent the importance of connecting the commerce of the Great Lakes with the Hudson and New York city. The Erie Canal is the only canal that has been built to connect the waters of the Atlantic along the coast of the United States with the Great Lakes and the great agricultural states of the west. The New York Central has four tracks connecting Albany with Buffalo, and the Lake Shore has two tracks. Heavy trains are passing constantly both ways on these lines, and the tonnage is enormous. But we are not able to understand why so much freight should pass along the Mohawk Valley and down the Hudson till we observe that there is no other low-level, easy way of getting across the Alleghany Mountains to the Atlantic. All the other railroads through southern New York and Pennsylvania are compelled to climb more than two thousand feet over mountain ridges to get to Pittsburg or Buffalo, while farther south in Virginia the mountains are still more rugged. The shipment of grain, meat, and other heavy products by way of the Great Lakes to Buffalo is enormous, and most of these goods find their way down the Mohawk Valley and the Hudson to New York.

By this broad survey of the commerce of the United States, we are able to see that the Hudson River and New York city are the outlet toward the sea for the richest and most productive interior parts of the United States, and the people of New York state are now seriously considering the expenditure of one hundred millions of dollars in enlarging and deepening the Erie Canal.

The importance of this traffic route is further seen by the fact that "80 per cent of the people and 90 per cent of

the wealth of New York state are in the counties along the canal and the Hudson River."

The cheapness with which raw materials can be secured over this main traffic route has made the cities along it

FIG. 6.

The State Capitol at Albany. (Copyrighted by G. P. Hall & Son, N.Y., 1899.)

the centres for the most extensive manufacturing, as Rochester, Utica, Albany, Troy, and many others.

Albany on the upper Hudson has a very favorable location at the junction of the two canals from Lake Champlain and Lake Erie. The New York Central, the Fitchburg route through the Hoosac Tunnel to Boston, and

other important lines make it also a leading railroad centre.

Just before joining the Hudson the Mohawk drops over a rock ledge, giving the important water-power which has built up the manufactures of Cohoes. There is also water-power at Little Falls and at Glens Falls.

FIG. 7.

The water-power in the Hudson at Glens Falls. (Copyrighted, 1890, by S. R. Stoddard, Glens Falls, N.Y.)

The valley of the Hudson has witnessed many interesting events in American history. From the days of its first exploration by Henry Hudson till the close of the Revolution, it was the scene of great military campaigns. The first settlements along the valley by the Dutch and English, the dealings with the Mohawks and other Iroquois tribes, the campaigns of the French and Indian wars, Burgoyne's expedition and its battles, the story of Arnold and André, the operations of Washington, the important forts at many points along the Hudson, the Mohawk, and Lake Champlain have added greatly to the interest of the people in this most popular of American rivers.

The banks of the Hudson are also crowned with a number of interesting monuments : the tomb of General

Grant, which overlooks the river from a commanding point near Columbia University at the upper end of Manhattan Island; the monument at Tarrytown to the captors of Major André; and the battle monument on the field of Saratoga. At Bennington and West Point are also historic memorials.

Washington Irving has thrown a romantic interest into many of the scenes along the Hudson. His home at Sunnyside, near Tarrytown, his burial place near the Old

FIG. 8.

A view of the Columbia University Library and other buildings. The Hudson River and Palisades are in the background. (Copyrighted by G. P. Hall & Son, N.Y., 1891.)

Dutch Church, the stories of Sleepy Hollow, Dolph Heiliger, and Rip Van Winkle, besides the Indian legends and warlike exploits for which the valleys of the Hudson and Mohawk are noted, lend the charm of poetry and romance to this whole region. Some of Fenimore Cooper's novels also find their theatre of action on the Hudson, as "The Last of the Mohicans." It is a curious fact that the stories of Irving and Cooper have lent as great an interest to the scenery of the Hudson as great battles and warlike campaigns.

In comparing the Hudson with the Connecticut, Dela-

ware, Susquehanna, and Potomac, we may get a still better notion of its size and importance. The Connecticut is 450 miles long while the Hudson is but 300. But the Connecticut is not a drowned river valley, and is navigable only for smaller vessels, being aided by artificial dams and channels at various points. This river has no canal outlet to the commerce of the west, and as a traffic route it is of no special importance.

The Delaware, like the Hudson, is open to the ocean tide as far as Trenton, 155 miles, and is navigable to this point. Philadelphia is located not far from its mouth, and is reached by large steamers. But the Delaware Valley opens out no good traffic route to the west, and above Philadelphia has no great commercial value.

The Susquehanna is 400 miles long and rises in the plateau of central New York. It is a shallow stream of little value for navigation and opens up no easy passage for a canal or railroad across the Alleghanies.

The Potomac is 400 miles long, and has tide-water navigation for large ships to Washington. Above this are falls and rapids, and the plan of building a canal along this route to Pittsburg was finally abandoned for a railway which rises to a height of 2400 feet in crossing the mountains.

The James and other rivers farther south are still less able to break through the mountain barrier separating the east from the west, although the great valley of Virginia does open a good route for a railroad into East Tennessee.

After such a survey of the rivers flowing to the Atlantic seaboard, it is quite clear that the Hudson River and Mohawk alone offer an easy low-level route for a canal and for railroads, for the shipment of heavy products back

and forth between the east and west. The great bulk of the surplus agricultural products of the middle west and lake states find their way along the lakes and by way of the Hudson Valley to New York city and then to Europe. This makes New York city the leading seaport of the United States. About half of the imports and exports of the United States thus pass through New York harbor.

The Pennsylvania Central, Baltimore and Ohio, and other roads crossing the Alleghanies to the west, also carry a large quantity of goods, but the Hudson River route is so much easier and cheaper that it naturally gains the bulk of the trade.

The Hudson is one of the shortest of American rivers, but the fact that it is a drowned valley and connects easily with the Great Lakes has made it the most important waterway in America.

In later studies the Hudson may be compared with the Ohio, Mississippi, and other American rivers.

Later still in the course, in studying Europe, the Thames, the Rhine, and other navigable streams may be compared with the Hudson as to commercial importance, scenery, and historical interest. Such comparisons are valuable in bringing out more clearly the chief points both in advance and in review work.

THE HOOSAC TUNNEL

THE Hoosac Tunnel, which pierces the Hoosac Mountain wall in western Massachusetts, is the chief avenue through which the commerce of New York state and the west finds its way to Boston and New England.

The Hoosac and Taconic Mountain ranges, extending north through western Connecticut and Massachusetts, were for many years a serious obstruction to commerce between New England and the western states.

When the Erie Canal was completed from Buffalo to Albany, the people of Boston and New England felt that the rich commerce of the west would be lost to them and fall to New York city.

To prevent this, the people of Massachusetts, in 1825, through its legislature, appointed commissioners to survey a canal route from Boston to Albany, so that a water line should be kept open from Boston to Chicago and New Orleans. The commissioners reported in favor of a tunnel for the canal through the Hoosac Mountains at the point where the railroad tunnel now passes.

But about this time and soon after, railroads began to be built, and in a few years canal schemes were given up in favor of railroads.

Loammi Baldwin, the first engineer to survey the route for the canal, was enthusiastic in favor of this project. He said that "the finger of Providence had pointed out this route from the east to the west." A friend standing

by said, "'Twas a great pity the same finger wasn't thrust through the mountain."

The whole mountain range between Connecticut and the Hudson is many miles across, but the central range is only five miles through. On the east side the Deerfield River has cut its way for thirty miles from the very foot of the central ridge of the Hoosac range to the Connecticut River, and furnishes an easy route for a railroad to the base of this mountain wall. On the west the Hoosac River, with its deep valley, comes close against the central mountain wall and winds westward to the Hudson, furnishing likewise an easy route for railroad traffic. But the backbone of the Hoosac ridge rises seventeen hundred feet above these valleys and is five miles across. It was necessary to pierce this mountain with a railroad tunnel if Boston and New England were to have their proper share of the vast commerce of the west.

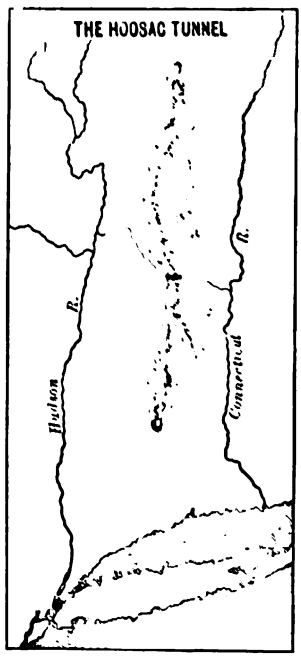


FIG. 9.

As early as 1842 a railroad from Boston to Albany had been completed, by way of Springfield and Pittsfield, which climbed over the mountains farther south with steep and difficult grades; but this was too difficult a route for railroad traffic on a large scale, and in 1850 the

Troy and Greenfield Railroad Company was organized to build a road from Greenfield to Troy, there already being a road completed from Boston to Greenfield. Boston also has other important railroads connecting less directly with the west, as the Grand Trunk of Canada, coming down through Maine, the Vermont Central, and the road to New York. But none of these bring Boston into direct touch with the commerce of the lake states and the great west.

In 1852 the railroad company organized to construct this road began work on the tunnel. It was decided to enter the mountain from both sides at once, so as to hasten the completion and render the work easier. Careful surveys and measurements across the mountain were necessary so as to cause the two tunnels to meet exactly in the middle of the mountain. The floor of each tunnel was sloped upward at the rate of twenty feet to the mile, so as to allow the water, which was constantly flooding into the parts excavated, to flow out and into the streams. Great care was taken in the surveys and measurements across the mountains, so as to bring the tunnels face to face when the work should be completed after years of labor. The digging was first begun on the east side, and a great drilling machine weighing seventy-five tons was set up. It drilled a circular groove into the face of the cliff about twenty feet in diameter and a foot wide. Then the exposed rock was to be split and blasted out. This machine soon broke down, and was sold for old iron. For several years after this hand drills were used, and into the holes drilled into the face of the rock charges of powder were placed and exploded so as to crush and shatter the rock. But the progress made with the hand drills was so slow that it was necessary to find a more rapid mode of exca-

vating the rock. A machine drill was invented to be driven by compressed air, as steam-engines could not be used in the tunnel on account of the smoke and gases produced. The compressed air was conducted from the power house outside the tunnel by means of large iron pipes to the drilling machine placed at the upper end of the tunnel. By means of these machine drills the men were able to push the tunnel forward at the rate of 150 feet a month on the east side and 90 feet on the west side, where the rock was harder.

The portal of the tunnel in the east end is in the solid rock and is twenty feet high and twenty-four feet wide. For the removal of the broken rock to the mouth of the tunnel, cars drawn by mules and running upon a track through the tunnel were used at first. But as the distance increased this was found too slow a process, and a small steam-engine placed near the entrance was used to haul the cars swiftly back and forth.

Gunpowder was used in the softer rock for blasting purposes, but in the harder rock nitroglycerine cartridges from one and one-half feet to two feet long and one and one-half inches in diameter were used. Several of these were inserted at one time into the holes drilled into the face of the rock, then connected with a fuse and electric wires leading to an electrical machine some distance down the tunnel. When the electric current was turned on, a deafening noise was heard, and the rock mass was shattered into fragments. When the work was in full progress, the noises in the tunnel were terrific, the rattling of the cars, the pounding of the drills, and the explosions of dynamite in the narrow passage creating a fearful tumult.

The men worked in three divisions: one, at the upper end

of the tunnel, were blasting out a passage twenty-four feet wide and eight feet high ; a second group half a mile farther toward the cntrance were taking off six feet more from the top of the tunnel. A third group still nearer the entrance completed the arch to a height of twenty feet. The men worked also in relays of three divisions, eight hours each, and kept the work up day and night.

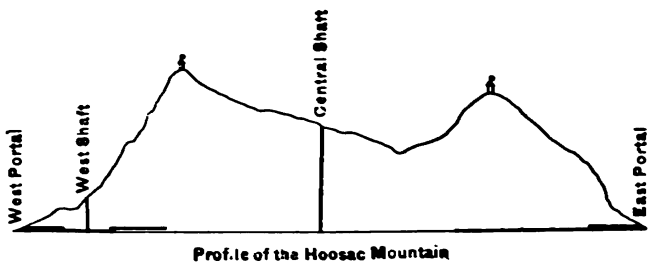
On the west side of the mountain, as the tunnel was pushed into the hillside, the engineers soon came upon a soft, crumbling rock almost as loose as quicksand. The walls caved in and filled up the tunnel as fast as it was dug, and it was extremely difficult to make any headway. A complete casing of timber was built close up to the end of the tunnel and extended forward as fast as the crumbling material was removed. Under this framework a heavy brick arch was built to support the weight above. As the loose materials at the bottom would not support the walls of the arch, an inverted brick arch was built at the bottom of the tunnel, and thus a complete brick tube was formed. In this manner the tunnel, seven layers of brick in thickness, was extended 700 feet through the soft and crumbling rock.

To avoid this crumbling rock the miners climbed the side of the sloping mountain and about half a mile from the west entrance sunk a shaft 318 feet deep to the level of the tunnel, and lifting the material through the shaft began to extend the tunnel eastward and westward.

The Hoosac mountain ridge, as shown by the diagram, consists of two ridges with a valley between them. In order to excavate the tunnel more rapidly a shaft was sunk in this upper valley to the level of the tunnel and the work of excavation was extended in both directions, the rock

and dirt being lifted to the top of this shaft in cars and dumped. This central shaft was 1030 feet deep and required four years of labor before the level of the tunnel was reached. It was elliptical in form, twenty-seven feet the long way, parallel with the tunnel and fifteen feet wide. Of course the most accurate mathematical calculations were necessary to determine the exact level, and to keep the direction of the tunnel at the foot of a narrow shaft 1030 feet deep.

During the time of tunnelling and sinking the shafts many serious accidents occurred and many lives were lost.



Profile of the Hoosac Mountain

FIG. 10.

The worst of all these accidents occurred at this shaft when it had been sunk about six hundred feet. A gasolene engine had been used for lighting the shaft, but was declared unsafe. In a second effort to use it, the buildings at the top of the shaft caught fire, and the engineer was driven from his post. Thirteen men who had just gone to the bottom of the shaft perished miserably, being probably suffocated by the smoke of the falling timbers.

When the enterprise of building this tunnel was just begun, it was in the hands of a railroad company. But the legislature of Massachusetts, after repeated requests, in 1854 subscribed $2,000,000 to the enterprise on certain

conditions. In 1862 by the foreclosure of a mortgage held by the state the whole management fell to the commissioners appointed by the state. As the work progressed, the amount needed for its completion increased rather than diminished. When the tunnel was finally completed, in 1875, after twenty-two years of labor, it had cost $14,000,000. The work was great and difficult beyond expectation. When it was begun no such vast undertaking had been tried in this country or in Europe. At the present time scores of trains pass through it daily, carrying the grain and meats of the west to Boston and Europe and taking back the manufactures of New England and Europe.

The railroads that cross the Alleghany and Rocky mountains of North America pass through many tunnels, but none so long and difficult of construction as the Hoosac. At Port Huron, Michigan, a tunnel passes under the Detroit River. In Chicago two tunnels pass under the Chicago River.

The railroads crossing the Alleghanies from east to west have many tunnels piercing the mountains. Usually the roads follow the valleys of streams, but in crossing the ridges which form the watersheds between rivers, it is often found necessary to cut a tunnel. The Baltimore and Ohio road with its branches has forty-four tunnels, the combined length of them being more than seven miles. The Chesapeake and Ohio road has about seven miles of tunnels in crossing the Alleghanies.

The Rocky Mountains are tunnelled in many places by railroads. One of the great tunnels is in the Cascade Range near the Columbia River in Washington.

In cities like New York, Chicago, St. Louis, and Bos-

ton, we find tunnels for railroads. In St. Louis a great tunnel reaches from the end of the great bridge under the business part of the city and emerges again shortly before reaching the Grand Central station.

In Chicago the water supply is carried through tunnels built under the lake from two to four miles to the large cribs which serve as intakes.

It is evident, therefore, that tunnels serve two distinct purposes, — either to pass under rivers or lakes or to penetrate mountains.

One of the great tunnels of the world is the one in the Alps, connecting Italy and France and called the Mt. Cenis tunnel. It is 4237 feet above the sea, nearly eight miles long, and cost $15,000,000. It is not built in a straight line, but curves through the mountain, and is wide enough for two double railroad tracks. It was built about the same time as the Hoosac tunnel. Though it was begun later, it was finished first, but two great states (France and Italy) were interested in its construction. The St. Gothard tunnel between Italy and Switzerland was built later. It is the longest tunnel in the world, being rather more than nine and one-fourth miles long.

There has been much talk of building a tunnel under the English channel connecting France and Germany. The shortest distance across the channel is thirty miles.

COD-FISHERIES

THE cod-fisheries along the shores of New England and farther north are a great source of food and wealth to the people. The principal centre for cod-fishing and other closely related fisheries is Gloucester on the northeast coast of Massachusetts.

The people of New England from the earliest exploration and settlement found the coast swarming with excellent fish, such as cod, mackerel, halibut, shad, and salmon. John Smith, in his first exploration of the New England coast, described these rich fishing grounds, and showed that they would prove a great source of profit to the settlers. It was fortunate that the early colonists found such an abundant supply of food in the near-by seas, as the land was not very fruitful and to this day has remained a poor farming country.

There are several reasons for such a stocking of New England waters with choice food fishes. There are, first of all, excellent feeding grounds for fishes in the shallow bays and inlets throughout these coasts, from Massachusetts to Newfoundland. These and the river mouths are good spawning grounds for salmon, shad, and other varieties. The rocky coast also allows the collection of seaweed, and a matting on the shallow bottom, among which the fishes find abundance of small animal food.

Along the shores and out from them are many shallow waters called banks where cod, halibut, and other fish are found in vast numbers. This whole sea-coast has been sunk to a lower level than formerly, and the sinking has caused many bays and inlets and a very irregular coast-line. The flat shoals or banks extending out along the coast under water are due to this sinking, and furnish the fishes with the shallow feeding grounds where they love to gather.

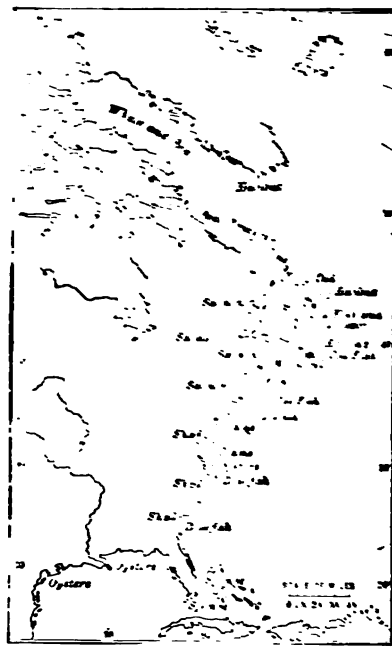


FIG. 11.
Sections where ocean fish are found.

Two kinds of fishing are commonly carried on, the shore-line fishing and the deep-sea fishing on the great banks, extending one or two hundred miles into the sea.

In recent years, the shore-line fishing has diminished in importance, while fishing on the banks, especially along the coast of Nova Scotia and Newfoundland, has employed hundreds of fishing schooners. For three miles out from the shore the fishing belongs wholly to the country whose shore it is, but beyond the three-mile limit the fishing is free to all nations alike.

The shore-line fishing is carried on chiefly by single fishermen, each in his boat. At the present time we find the lone fisherman all along the coast of northern New England, but especially in the more remote parts of the coast. He has his dory, in which he goes out upon the sea every day the weather permits. His home, often no more than a shanty surrounded by a small and not well-kept garden, is on the shore of a cove which furnishes partial or complete protection to his boat. Early each morning, at an hour when most of us are abed, he goes out in his boat to attend to his lobster pots, nets, and trawls, sailing when possible, rowing when necessary. His life is a simple one and his needs are few, but he is his own master, free and independent.

FIG. 12.
A fisherman, dory, and lobster pots.

Many of the fish brought in by the single fisherman in his dory are sold fresh in the markets along the coast.

Most of the fishing on the banks is carried on by schooners which are fitted out at Gloucester, or it may be at Boston or Provincetown. The fishing schooners of recent times are fast-sailing boats, well equipped and seaworthy, and are sent out mostly by large companies, which fit them out for the voyage. The best of them resemble pleasure yachts. Their lockers are well supplied with

fresh vegetables, fresh iced meats, and the best canned goods, and the hard-working fishermen are well fed. The sides of the vessel are supplied with water-tanks, connected by good pipes and faucets with the basins for handling the fish. All the tools and machinery needed for an easy and quick cleaning and packing of the fish are sup-

FIG. 13.
A fishing schooner.

plied. The cabins are furnished with pictures and conveniences like a modern house. The captain or skipper is a well-seasoned shipmaster, and his crew, if possible, are experienced fishermen. The crew share the profits of the catch, after expenses are taken out, and are thoroughly interested in the success of their work.

"Long since, the demand for fishermen in Gloucester has far exceeded the supply of local fishermen; and con-

sequently men have flocked there from many points, as the coast of Maine, Nova Scotia, Prince Edward Island, Newfoundland, and the Portuguese Azores. Nevertheless, with all this diversity of race, they are banded together as partners, as their predecessors were when fishing two in a boat. The men are not hired by the owners of the vessels at so much a day, but work together as partners in a common enterprise. A firm may own dozens of vessels, and these are fitted out with the necessary apparatus of

FIG. 14.

A view in Gloucester harbor, showing the fishing schooners, the wharves where the fish are landed, and the buildings in which they are stored.

food, each man being charged with his share of the expense of outfitting. When the trip is sold, these expenses are deducted, the firm bearing its share, and then the profits are divided, the firm naturally getting the larger portion, since it has supplied the vessel and the largest part of the outfit, and the captain, or 'skipper,' receiving more than the men. The result is that each man feels a keen interest in the success of every trip; and, barring the element of luck, his share bears a direct proportion to the energy with which he and his fellows work. All considered, it is one of the most satisfactory and successful

instances of coöperation between labor and capital that the industries of our country offer. There are no strikes."

The fishing schooners start for the Banks in May or June and spend three or four months laying in a cargo of cod. Before starting out, the hold of the ship is well filled with salt, to be used in salting down the fish as fast as they are taken.

When once upon the Banks, the captain of the fishing schooner shifts about from place to place in search of the best fishing grounds. By long and toilsome experience he has become expert in judging the weather and the habits of the fish in wandering along the sea bottoms. He knows the ups and downs of the sea bottom all over the Grand Banks as well as the farmer knows his fields.

As soon as he has found a good fishing ground, the schooner is anchored, and the dories or small boats which are swinging in their nests upon the deck are let down. The hardy, skilled fishermen leap into them, already well supplied with fishing tackle and bait, and begin to set their hooks and drop them in for the catch. Each fisherman seeks to outdo the others in the number of fish he can bring back in his dory as the fruit of his day's catch. As the boats are swung to the deck and the fish unloaded into the bin, a tally is kept of each man's fish, and much sport is made of those who come in with a poor catch.

After all the fish have been pitched into the pen on deck, and the hungry fishermen have had their supper, the work of "dressing down," or cleaning and packing them in the hold, takes place. Kipling's "Captains Courageous" gives the following description of the dressing down: "The shadow of the masts and rigging, with the never-furled riding-sail, rolled to and fro on the heaving

deck in the moonlight; and the pile of fish by the stern shone like a dump of fluid silver. In the hold there were tramplings and rumblings where Disko Troop and Tom Platt moved among the salt-bins. Dan passed Harvey a pitchfork, and led him to the inboard end of the rough table, where Uncle Salters was drumming impatiently with a knife-haft. A tub of salt water lay at his feet.

"'You can pitch to dad an' Tom Platt down the hatch, and take keer Uncle Salters don't cut your eye out,' said Dan, swinging himself into the hold. 'I'll pass salt below.'

"Penn and Manuel stood knee-deep among cod in the pen, flourishing long knives. Long Jack, a basket at his feet and mittens on his hands, faced Uncle Salters at the table, and Harvey stared at the pitchfork and the tub.

"'Hi!' shouted Manuel, stooping to the fish, and bringing one up, with a finger under its gill and a finger in its eye. He laid it on the edge of the pen; the knife-blade glimmered with a sound of tearing, and the fish, slit from throat to vent, with a nick on either side of the neck, dropped at Long Jack's feet.

"'Hi!' said long Jack, with a scoop of his mittened hand. The cod's liver dropped in the basket. Another wrench and scoop sent the head and offal flying, and the empty fish slid across to Uncle Salters, who snorted fiercely. There was another sound of tearing, and the fish, headless, gutted, and open, splashed in the tub, sending the salt water into Harvey's astonished mouth. After the first yell, the men were silent. The cod moved along as though they were alive, and long ere Harvey had ceased wondering at the miraculous dexterity of it all, his tub was full.

"'Pitch!' grunted Uncle Salters, without turning his head, and Harvey pitched the fish by twos and threes down the hatch.

"'Hi! Pitch 'em bunchy!' shouted Dan. 'Don't scatter! Uncle Salters is the best splitter in the fleet! Watch him mind his book!'

"Indeed, it looked a little as though the round uncle were cutting magazine pages against time. Manuel's body, cramped over from the hips, stayed like a statue; but his long arms grabbed the fish without ceasing.

"Down below, the rasping sound of rough salt rubbed on rough flesh sounded like the whirring of a grindstone — a steady undertone to the 'click-nick' of the knives in the pen; the wrench and schloop of torn heads, dropped liver, and flying offal; the 'caraah' of Uncle Salters's knife scooping away backbones; and the flap of wet, opened bodies falling into the tub.

"At the end of an hour Harvey would have given the world to rest; for fresh, wet cod weigh more than you would think, and his back ached with the steady pitching. But he felt for the first time in his life that he was one of a working gang of men, took pride in the thought, and held on sullenly.

"'Knife oh!' shouted Uncle Salters, at last. Penn doubled up, gasping among the fish; Manuel bowed back and forth to supple himself; and Long Jack leaned over the bulwarks.

"After a few moments' rest while the knives were being changed: —

"'Hi!' With a yell from Emanuel the work began again, and never stopped till the pen was empty. The instant the last fish was down, Disko Troop rolled aft to the cabin

with his brother ; Manuel and Long Jack went forward ; Tom Platt only waited long enough to slide home the hatch ere he too disappeared. In half a minute Harvey heard deep snores in the cabin, and he was staring blankly at Dan and Penn."

Sometimes, instead of the men going out in their dories to fish separately with hook and line, a long line is laid

FIG. 15.

Cod fishing by means of a trawl.

out across the water, to which short lines with baited hooks are fastened every few feet. This is called long-line fishing or trawling. Such a trawling line with shorter lines attached is packed carefully in a tub and lowered into a dory which anchors one end of it to a buoy near the schooner. As the dory is moved out by the oarsman away from the schooner, another fisherman baits the hooks and drops them into the water. In this way two or three tubs full of line are stretched out in one course, perhaps a mile in length. The farther end is also anchored, and corks at intervals support the main line.

Gathering the fish from the trawling line is difficult and dangerous in a rough sea. Kipling gives the following: "Underrunning a trawl means pulling it in one side of the dory, picking off the fish, rebaiting the hooks, and passing them back to the sea again—something like pinning and unpinning linen on a wash line. It is a lengthy business and rather dangerous, for the long, sagging line may twitch a boat under in a flash.

"The fish bit at the newly baited hooks from which their brethren had just been taken, and Tom Platt and Long Jack moved methodically up and down the length of the trawl, the boat's nose surging under the wet line of hooks, stripping the sea-cucumbers that they called pumpkins, slatting off the fresh-caught cod against the gunwale, rebaiting and loading Manuel's dory till dusk."

Sometimes when the cod are thick and hungry, the men fish from the deck of the schooner.

Dangers ever beset the men whether on the deck of the schooner or in their dories. The heavy fogs which wrap the Banks in gloom are a sure cause of trouble. The fog often settles down suddenly and the dories are quickly shut out from the sight of the schooner and must go by sound of bell or horn or the instinct of the fisherman. Sometimes the men in the dories are lost and drift about for days, to starve or freeze or go down in stormy weather.

The path of the ocean steamers from New York to England is directly across these foggy Banks and such a swift moving steamship, suddenly looming up out of the dense fog, sometimes crushes into a schooner, splits it in two, and sends its crew to the bottom. Or, it may be, an iceberg,

floating down from the north, invades the foggy Banks and threatens destruction to the schooners.

At times the fishing vessels collect in large numbers at some favorable fishing ground and anchor near together. In case a storm comes up and an anchor gives way, the schooner is driven recklessly among the other boats and a collision may sink both vessels and their crews.

Professor Tarr says in "The Fishing Industry of New England": "In order to set the trawl, and to remove the fish from it at intervals, men must leave the vessel in their dories. If a snow squall arises or a fog sets in while the men are out, they are apt to be separated from their schooner and, drifting about, become hopelessly lost in the open ocean. Every year lives are lost in this manner; and very often men are adrift for days before being picked up, perhaps crazed with thirst or almost starved and frequently badly frozen.

"In some years over two hundred men are lost from the port of Gloucester, and every year there are scores of lives sacrificed. The result is that the percentage of widows and orphans in Gloucester is unduly large; yet the freedom, independence, and excitement of the life, added to the possibility of profit, induce men to engage in the industry. But the wives and mothers ashore, lacking the excitement, wait, watch, and pray, spending sleepless nights listening to the roar of the storm waves with fear and trembling, for they know that this very storm may rob them of their dear ones. Then, when it is time for the return, they watch and listen; and, alas, in far too many cases anxiety gives place to fear, then to dread uncertainty, and finally to hopeless certainty that the vessel will never again enter port, and that no

one will ever know more than that it lies at the bottom of the sea."

Gloucester has grown in the last few years to be the most important centre of the fishing industry in New England. Formerly it was less important than Provincetown on Cape Cod or Annisquam near by. But as larger boats and schooners came into use on the Banks, Gloucester was found to have a deeper harbor and entrance, so that the business shifted to this place. Gloucester has also the advantage of extending far out into the sea on the peninsula of which Cape Ann is the point, and is thus nearer to the fishing grounds. Again, Boston, the great centre of trade, is not far away, and both fresh and salt fish are sent in large quantities to Boston, and from there distributed over the country. Boston itself is also a very important harbor for fishing schooners, and especially for the trade in fresh fish. Fishing schooners coming into Gloucester often have their halibut and other fresh fish packed in the hold on ice and thus kept fresh for weeks or months till it is shipped in refrigerator cars to New York and other cities.

Most of the cod, salted down in the holds, is brought into Gloucester in schooner loads. "Arriving in port the cargo is transferred from the ship to the wharf, where the fish are placed in large hogsheads, called *butts*. There they are left soaking in the brine until the time comes for drying them. For that purpose the fish are spread upon the flakes, which consist of frames two or three feet above the level of the wharf, upon which are many crosspieces arranged much as laths are in a house. This permits the air to reach the un-

der as well as the upper side of the fish. After being thoroughly dried, many of the fish are sent away whole to be sold as salted cod, and these fish find their way all over the country. Of late, however, an important industry of preparing the cod more carefully for market has sprung up. For this purpose the skin and bones are carefully removed, and the fish is torn into shreds and packed in boxes as boneless or shredded cod."

As in the case of other large industries centred in one place, the waste products, such as skins, bones, and heads, have found important uses. For the manufacture of glue and fertilizer large factories have been built at Gloucester, where these disagreeable products are converted into valuable articles of commerce and the waters of the harbor saved from pollution.

It is natural also that other industries for the manufacture of anchors, cordage, fish nets, and ship supplies should grow up in Gloucester. In this way Gloucester has grown to be the great centre for the fisheries and other closely related trades. The harbor of Gloucester, with its schooners, docks, and drying wharves, is one of the places of lively interest to the visitor. Four hundred fishing schooners go out from this port and the fish brought in are scattered to almost every grocery store in the United States. Most of the fish brought in is consumed in our own country. As Lowell is famous for cotton manufacture and Pittsburg for iron, Gloucester, a city of twenty-eight thousand people, stands foremost in the fish industry.

When we consider the risks, dangers, and hardships connected both with the shore-line and outlying banks

fishing, it is plain that a hardy and independent race of men is needed for such a business. From the earliest times the fishermen of the New England coast have been a bold and fearless set of men, ready to face danger, hardship, and the severest strain of toil. Through long and hard experience they became skilful seamen and shipmasters. In time of war the United States has usually found among these fishermen its best men for the fleet. During the Revolutionary War, and still more during the War of 1812, these men proved themselves heroes in many waters. Later, during the Civil War, they were found equally serviceable to their country.

The results of the Spanish-American War, in which they also served, were curiously advantageous to the fishing business. Porto Rico and Cuba, as a result of this war, have been opened to the trade in fish from the New England coast. This is important because Catholic countries use a large quantity of fish, and the products of the cold north are thus made to serve the needs of the tropical south.

The sea captains or skippers and many of the sailors who go out from Gloucester are men with families who own their own comfortable homes. Others are single men, who are apt to spend their money recklessly when they come into port.

On account of the greater concentration of the fishing business in two or three cities, many of the old wharves and fishing towns have been largely abandoned and are falling into decay. Instead of fishing villages, they have become largely summer resorts for seaside visitors.

Farther south along the coast of the United States, especially in Long Island Sound and Chesapeake Bay, the oyster fisheries are extremely important and furnish employment to thousands of men. Even as far south as the coast of Florida, oyster fisheries are important and supply a large amount of food product.

On the northwestern coast of the United States, British Columbia, and Alaska very extensive salmon fisheries have developed, in particular along the Columbia River. The canned salmon, and even fresh salmon, sent in refrigerator cars to the east, have competed in the market with the products of the New England fisheries; but the distance is so great that New England has held the chief place in the fish market.

Along the Great Lakes are also extensive fisheries in lake-trout or whitefish and other varieties, which are among the best of food fishes. The smaller lakes and rivers of the United States are also locally important as sources of the food fishes.

The government of the United States has an important department called the Fisheries Commission, whose business it is to study the various fresh and salt water fishing grounds of the United States. It is their work also in every way possible to protect and extend the fishing industries, to establish fish-hatcheries, and to distribute young fish in waters where they may increase in numbers. Thus attempts are being made to restore the coast-line fisheries along the coast of New England by planting young fish in the shore waters.

As already indicated, the great fishing grounds along the Banks of Newfoundland are resorted to by fishing schooners of all nations. French vessels have always

been numerous along these shores, and the Canadian fisheries are very important.

In later studies, the great fishing grounds of the North Sea and all around the coasts of England and Ireland may be studied and brought into connection and comparison with the fisheries of our own country.

FIG. 16.

Relief map of Niagara River. Notice the broad, shallow, upper valley; the gorge; the whirlpool: the lower shallow valley; the escarpment separating the two plains; and the depression leading from the whirlpool to St. David's, marking the site of the buried gorge which causes the whirlpool. (Model by E. E. Howell, Washington, D.C.)

NIAGARA FALLS AND THE COMMERCE OF THE GREAT LAKES

NIAGARA FALLS lies midway between Lake Ontario and Lake Erie. Lake Erie is nearly 300 feet higher above the sea-level than Lake Ontario. About six miles south of Lake Ontario the level plateau in whose basin

FIG. 17.

Bird's-eye view of the Niagara River. Contrast the broad, shallow upper valley with the narrow, deep gorge below the falls.

Lake Erie lies drops down 300 feet to the plain which borders Lake Ontario. The Niagara River, in making its way from Lake Erie to Lake Ontario, must leap over this bluff or escarpment. At the present time the falls are about six miles back from the edge of the escarpment. A

stratum of limestone rocks 140 feet thick extends from the edge of this escarpment southward and, dipping gradually, passes under Lake Erie. The Niagara River, as it flows northward, drops over this ledge of limestone rocks at the present site of the falls. It is 160 feet from the edge of the cataract to the level of the river below. The remainder of the 300 feet of descent is made by the rapids above and below the falls and by the descent of the river. The falls on the American side are small and, in fact, constitute a part of the east bank of the river. The great Horseshoe Falls, which lie to the west of Goat Island, constitute the main part of the falls. Here the enormous body of water tumbles into a great chasm from three sides, and it is here that the main action of the water in grinding out the rocks takes place. Above the falls is a great series of limestone ledges, over which the broad river plunges, forming a wilderness of waters, as seen from the Three Sisters Islands, very

FIG. 18.
A view of Niagara Falls.

grand and impressive. In fact, the view up the river from the Three Sisters is one of the grandest scenes in nature. The Horseshoe Falls can be best appreciated from the *Maid of the Mist* as it sails up under the waters from below.

Below the falls is the deep, narrow gorge, with its precipitous walls nearly 300 feet high, through the narrow bottom of which gushes the swift river. How was this gorge formed? It extends about six miles to the edge of the escarpment. As the water tumbles over the edge of the falls, it decends into the river 200 feet deep. The underlying rocks beneath the limestone ledge, already described, are soft shales and sandstone. The rushing waters at the foot of the falls gradually wash out great caves in this softer rock, and the superincumbent mass of projecting limestone breaks off in great chunks and tumbles into the bottom of the river. In the centre of the Horseshoe Falls, where the water from three sides plunges into the deep caldron, the action of the water is so powerful as to grind up these loose rocks at the bottom and sweep the sand down the river. On the edges of the gorge, where the action of the water is less powerful, the broken rocks are not ground up and form a sloping side or talus which is found on both sides of the gorge throughout its course. In this way it has been found by close measurements that the falls are yearly receding toward the south, in the middle of the Horseshoe Falls at the rate of from four to six feet a year. During the present century the measurements have been quite accurate, so that the rate of recession is somewhat definitely known. With this as a basis efforts have been made to reckon the number of years necessary for the formation of the gorge, but the estimates have varied from six thousand to thirty thousand years.

The gorge between the falls and the escarpment is a most interesting scenic object. An electric railway descends along the eastern edge of the gorge and, passing close by the whirlpool rapids, proceeds along the foot of the cliffs till it reaches Lewiston at the outlet of the gorge. Here the Niagara River widens into a splendid stream, deep and broad, as it courses toward Lake Ontario. Another electric railway climbs the escarpment on the Canadian

FIG. 19.

Elevators on the water front of Buffalo. (Copyrighted by G. P. Hall & Son, N.Y., 1899.)

side, and on its return to the falls gives excellent views of the river and gorge from above.

If heavily laden grain ships start from Chicago or Duluth, how far can they proceed down the lakes before stopping to unload? If it were not for Niagara Falls, they would not stop at Buffalo, but pass on to Lake Ontario, and perhaps down the St. Lawrence on their way to Europe or New York. As a matter of fact, all the great lake vessels moving eastward are compelled to un-

load their cargoes at Buffalo. If it were not for Niagara Falls, would there be any need of an Erie Canal? or a Welland Canal? Would there be any great city at Buffalo? If great vessels could pass freely from Lake Erie to Lake Ontario, what part of the Erie Canal would still be serviceable? There is at present a branch of the canal from Oswego to the main canal and Albany. In this case what sort of a city would Oswego be? Perhaps the main body of commerce would go down the St. Lawrence, but there are difficulties in the navigation of the St. Lawrence, such as the rapids, which have made canals necessary, the short season of navigation at the mouth of the St. Lawrence, so far to the north, and the fact that all this commerce must pass through a foreign country. The probability is, therefore, that the canal, in any case, would extend from Oswego to Albany. So far as commerce is concerned, Niagara Falls is an enormous obstruction, making necessary the expenditure of many millions of dollars on canals and railways. Moreover, the traffic route from Chicago, Duluth, and the lake cities is by many times the most important traffic route in America,

FIG. 20.

Some of the raw materials which are readily brought to Buffalo by boat.

and Niagara lies at its centre, obstructing all free commercial intercourse. The vast importance of this trade route may be seen in the quantity of great staple products like corn, wheat, live stock, and packed meats which are shipped from Chicago and other lake cities to Buffalo, New York, and Europe. The greatest railroad trunk lines

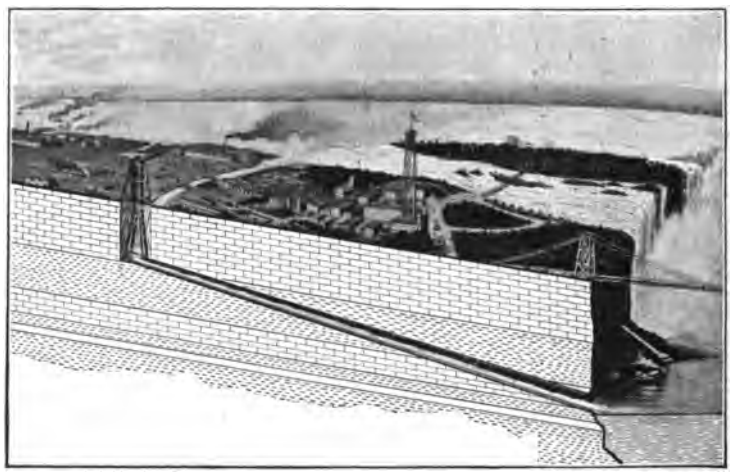


FIG. 21.

A section to show how the Niagara power is used. The wheels are placed at the base of the tube on the left-hand side, and the waste water then runs down through the tunnel and back into the river.

follow this route, such as the Michigan Central, the Nickel Plate, and others.

On the other hand, do the great falls perform any service to mankind to compensate for this inconvenience and difficulty? There is immense water-power at the falls, and a group of mills on the east side for many years has used a very small fraction of the water for moving mill-

wheels. But within the last few years engineers have constructed great water-wheels near the falls for producing water-power and for converting this power into electrical force. This result has been accomplished as follows: On the American side above the falls and a few hundred feet from the shore a huge shaft or well was sunk to a depth of about 160 feet. Its bottom was a little above the level of the river at the foot of the falls and from the bottom of the shaft a tunnel was run connecting it with the gorge at the level of the river below. Then a canal was opened from the river above the falls to the top of the shaft, and the water could be run from the river and dropped into the top of the deep shaft or well. Near the bottom of the shaft was built a series of great turbine wheels upon which the water from above could be dropped through large iron pipes. Shafting connected these turbine wheels with the power-house above at the top of the well where the water-power is converted into electrical force. It is being utilized by mills and factories and street-car lines within a radius of many miles from the falls. So great is the amount of power which can be generated at the falls and put to use in factories and shops, that it is expected that the country about Niagara Falls will become, in time, the greatest manufacturing centre in the world. Another reason for these hopes is the fact that raw products of many kinds can be shipped to this point at little expense.

In the early history of explorations we find that Hennepin and La Salle, in trying to navigate the upper lakes, met their greatest difficulties at Niagara Falls. It was necessary to carry a heavy forge and tools over the bluff and along the river to a point six or seven miles above the falls, where, in the rigors of a severe winter, forest trees

were cut down and a vessel was built for the navigation of the upper lakes. It was called the *Griffin* and was used by La Salle and his party in their first trip to Mackinaw and Green Bay. The Columbus caravels, which were objects of such interest at the Columbian Exposition, were taken up the St. Lawrence River and through the Welland Canal, reaching Chicago by the way of the lakes. Some of the smaller whaleback steamers have made the trip from Duluth through the locks at St. Mary's Canal, the lakes, and the Welland Canal, down the St. Lawrence to Liverpool.

Geologists have been anxious to determine the number of centuries since the Niagara River began to cut its gorge. In this way they would be able to determine the length of time since the glacial period or the ice age in North America. The great glacial sheet gliding down from the north at one time filled Lake Ontario so that the Niagara River could find no outlet into Lake Ontario. At that time the upper lakes must have found an outlet in some other direction. The old channel by which Lake Michigan sent its waters into the Illinois and Mississippi has been found. As the ice receded toward the north, and the waters from Lake Erie were first sent via Niagara over the escarpment toward Lake Ontario, the outlet of the St. Lawrence was still obstructed by ice. In those days the outlet to Lake Ontario was by way of the Mohawk and Hudson, and this old channel has also been located. If this were still true, it would remove some of the difficulties of our navigation.

If we compare the falls of Niagara, its gorge and rapids, with the falls of St. Anthony at Minneapolis, we shall find that a similar gorge extends from Minneapolis down the Mississippi about five miles to its junction with the

Minnesota. But this gorge is only one-third as deep, though about the same width, as the Niagara gorge. An examination of the rock strata at St. Anthony's Falls will reveal also a similar series of rocks, hard limestone above and softer rock beneath, and a similar recession of the falls. At Minneapolis, however, great flour mills worth millions of dollars have been established at the western edge of the falls, and the recession of the falls would render them useless. To prevent this a heavy framework of wooden chutes has been built and heavily buttressed, so as to completely cover the rocks at the falls and prevent them from wearing away, thus making the falls stationary. But the old scenic beauty has been destroyed. At Rochester, New York, where the Genessee River plunges over the escarpment toward Lake Ontario, a series of falls and gorges is found which is explained in the same manner as Niagara Falls. It will be of interest to compare other falls in North America, like those of the upper Missouri, Yellowstone Falls in the park, and the falls of the Columbia, with those of Niagara, to see if similar causes are operative. Later in the study of Europe, Africa, and other lands, we may compare the falls of the Rhine, of the Nile, the Zambezi, and the Congo with those of Niagara, in their effect upon navigation and traffic.

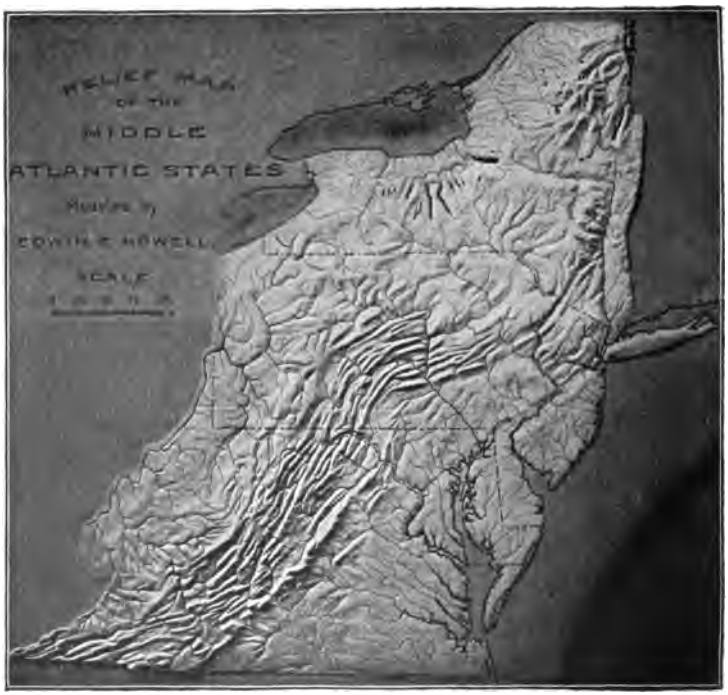


FIG. 22.

THE JAMES RIVER

THE James River, rising in the high crests of the Alleghany Mountains, drains a part of the Great Valley of

Virginia, and then breaking through the Blue Ridge at Balcony Falls flows across the uplands between the mountains and the border of the lowlands. Then, descending in rapids across the granite escarpment at Richmond, it flows through the tide-water lowlands, more than a hundred miles, to the southern end of Chesapeake Bay. Here, joining its waters with those of the broad bay, it does not reach the ocean till it passes between the opposite capes of Charles and Henry.

In passing from the highest ridges of Great North Mountain on the west, covered with heavy forests, till it reaches the tidal waters which mingle with the ocean, the James River travels through a widely diversified country, — high mountains, upland valleys, mountain gorges, pine-clad foot-hills, rolling plateaus, rocky ledges, sandy barriers, and rich lowland flats and marshes.

Just at the mouth of the James, one who is sailing up the river meets a number of interesting and well-remembered places. Old Point Comfort with its huge hotels, Fortress Monroe, Newport News on the north side of the broad entrance, and Portsmouth and Norfolk on the south side, and lying between the two are the wide-stretching waters of Hampton Roads, which has been called the finest landlocked harbor on the eastern coast of the United States. The harbor of Norfolk admits large ocean-going steamers, and it is the terminus of railroad lines from the west and south, which has made it a great shipping point for coal, cotton, lumber, tobacco, vegetables, and other products. Norfolk is also connected by navigable waters with Richmond, with Baltimore, Washington, and other cities on the Chesapeake, by canal through the Great Dismal Swamp southward to Pamlico

and Albemarle sounds, and with all the cities of the Atlantic coast and of Europe by the ocean.

At Newport News one may see one of the great shipyards for the building of ocean steamers and war vessels, supplied also with dry docks for the overhauling of great ships.

Near Fortress Monroe is the famous Negro and Indian School of Hampton, founded and long directed by General Armstrong.

In the waters of Hampton Roads in 1862 the little *Monitor* gave battle to the iron-clad battle ship *Merrimac* and saved the Union from what seemed a great danger. On the other side of the narrow peninsula which separates the James and the York rivers is Yorktown, where was fought the last great battle of the Revolution.

The mouth of the James, with its shallows and bays, like the other broad river mouths of the Chesapeake, abounds in fish and oysters. This is the favorite region for the best oyster farms, and these cities are centres for collecting and shipping fish and oysters.

Passing up the James River, a few miles of sailing brings us to the site of Jamestown, where the early colonists struggled for the first permanent foothold in the United States, and where John Smith showed himself so daring and prudent in providing for the settlers; and just to the north of this deserted place is Williamsburg, famous during colonial days as the capital of Virginia.

The low, rich land on these peninsulas at the mouth of the James and other rivers in Virginia has become in later years the great region of truck farming, where so many vegetables and small fruits are raised for the northern market, especially for Philadelphia, Baltimore, and other

cities on or near the coast. Potatoes, radishes, onions, lettuce, celery, sweet potatoes, strawberries, and melons are raised in large quantities and shipped to the north. The alluvial soils brought down by the rivers are very rich along these coasts.

The climate of the coast region is mild and moist because of nearness to the ocean, while the Alleghany Moun-

FIG. 24.

A view in the Dismal Swamp. The cypress knees and roots are seen rising to a level above the reach of high water.

tains shut out the cold northwest winds. Southward also on the lowlands of the Carolinas and Georgia truck farming has greatly extended, and along the Florida coast, even in winter time, lettuce, onions, tomatoes, celery, and fruits are shipped northward in great abundance. Not only along the low coast lands of Virginia, therefore, but all

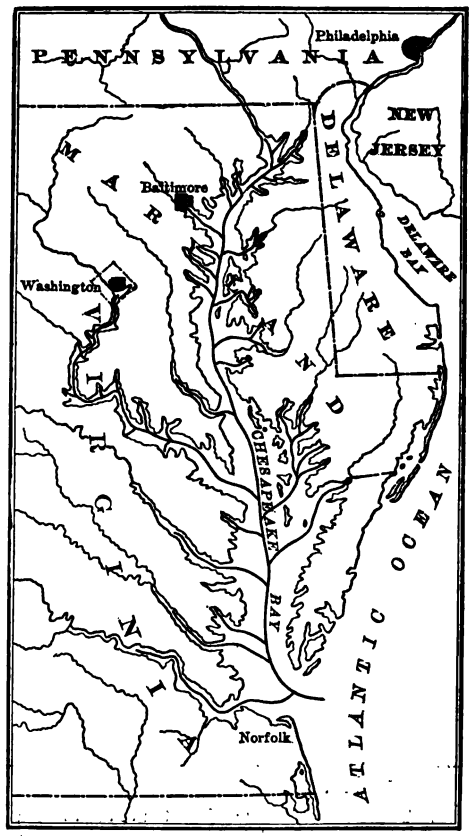


FIG. 25.

Map of Chesapeake Bay, to show (by heavy line) the way in which the various rivers would unite into a single trunk stream if the land were elevated.

along the Atlantic coast from New Jersey to the southern coast of Florida truck farming and small fruit growing have gained great importance.

Much of this lowland is sandy and barren and is unproductive except for forests of pine and oak. The region of the Great Dismal Swamp south of Norfolk is rich in cypress, pine, and cedar. Since the days of John Smith these pine woods have been used to produce tar and turpentine. From Virginia southward through the Carolinas, Georgia, and the far south into Florida, the low, sandy lands are rich in turpentine woods, and the coast cities like Norfolk, Charleston, Savannah, and Jacksonville are ports for its shipment.

The James River below Richmond is a tidal river; like the Hudson, it is a drowned valley. In fact, the whole Chesapeake Bay, with its broad estuaries of the Potomac, James, etc., was once above sea-level and the Susquehanna River flowed down past Cape Charles and Cape Henry and far beyond. The settling of these river valleys below the sea-level has admitted the ocean

FIG. 26.

James River Falls, showing the ancient rocks.

and formed those broad bays and estuaries which have so many excellent harbors, and have produced such fine oyster beds and fishing grounds.

Vessels requiring fourteen feet of water can sail up the James River as far as Richmond, 117 miles, where the river tumbles down over a ridge of granite rocks, 100 feet of fall in about six miles. This rocky ridge is the boundary line between the lowlands of the tide-water region of Virginia and the more hilly uplands. In the early history of Virginia the great tobacco plantations were

in this lowland belt, and as there were no railroads and few good wagon roads, the ships from the ocean came up the James and other rivers to the plantations and loaded from the private wharves of the planters. In those days there were no large cities, but since railroads have become the chief means of transportation, cities like Nor-

FIG. 27.

The Washington Monument and the State Capitol.

folk and Richmond have become great centres of population.

The city of Richmond is finely located on a group of hills at the upper edge of the tide-water region. This elevation above the lowlands gives it a healthier position, and the water-power of the falls naturally is used for flour-mills. Up to the time of the outbreak of the Civil War,

Richmond was the great centre of trade for a large part of the south. Ocean-going vessels came to its docks in large numbers. It was one of the chief centres for the tea trade with Asia. The tobacco business, both for manufacturing and shipment, was extensive, and the agricultural products of both the uplands and lowlands met here. The old Capitol building on the top of one of the hills is still the most interesting and commanding object in the city. Here are found the famous statues of Washington and Stonewall Jackson.

Soon after the war broke out Richmond was naturally made the capital of the southern Confederacy. The city was surrounded by heavy fortifications and earthworks. The old line of outer earthworks and ditches can still be seen three or four miles out from the city, while seven or eight miles out are some of the famous battle-grounds, which are much visited by tourists. Libby Prison in Richmond was famous during the war as the place where captured Union soldiers were kept. As the city of Richmond was evacuated at the close of the war the great warehouses were set on fire and the city much damaged.

Virginia had suffered more during the war than any other state. Great armies had marched back and forth, laying waste its fields, destroying its cities, and tearing up its railroads. Many great battles had been fought, and it was at Appomattox Court-House that Lee finally surrendered to Grant. The slaves had been set free, so the old system of labor was destroyed.

At the close of the war, therefore, the once prosperous city of Richmond was in ruins, and the whole state was in a miserable condition. It has taken many years to build up again the agriculture and commerce of the state. But of

late years Richmond has again become very important as a railroad centre, and as a manufacturing city for iron products and cotton goods. Tobacco is collected and manufactured extensively and the agricultural products are collected for shipment. It has now a population of eighty-five thousand and is much more important than it was before the war.

The upland region of Virginia, drained by the James River, from the edge of the tide-water to the foot of the Blue Ridge, is a rolling hilly country suitable for farming, where grain, corn, tobacco, and fruits are raised and where cattle and other live stock are plentiful. It is a healthful and productive region where there are many good farms and the county seats are important towns and cities.

That part of this upland which lies close to the foot-hills is called the Piedmont plateau and has a number of fine cities like Lynchburg, Danville, and Charlottesville. Charlottesville, on a north branch of the James River, is the seat of the famous University of Virginia, founded by Jefferson. The well-wooded foot-hills, with evergreen and hardwood trees, lie about Charlottesville, and the hazy outlines of the Blue Ridge are seen toward the west. About three miles from Charlottesville, on the rounded summit of a hill several hundred feet above the town, Jefferson laid out extensive grounds and built his home, Monticello. A fine old road winds up through the heavily forested hillside, past the monument and burial-place of Jefferson, to the grand old mansion with its broad porches. A few old trees, the remnants of the ancient forests, shade the lawn from which one surveys a broad sweep of valley and mountain. On one side, just at the foot of the hills, lies Charlottesville in plain sight, and just beyond it the domes

and colonnades of the University buildings. On the other side and just in front lies a wide-spreading valley enclosed between high ridges, and within this stretch of vision are the old homes of several Presidents of the United States,

FIG. 28.
James River in the Blue Ridge Mountains.

as Monroe and Madison, and the birthplace of George Rogers Clark and his brother, William Clark, famous in the Lewis and Clark expedition up the Missouri. The historic associations of the region about Charlottesville make it of great interest to all Americans.

To the southwest of Charlottesville the James River breaks through the Blue Ridge Mountain range, making a famous gorge, and through this gap pass two of the railroads connecting the inner valley with the Piedmont district just east of the Blue Ridge. On a railroad map we may notice that there are several of these gaps in the Blue Ridge where the railroads pass through.

The upper James and its branches drain a considerable part of the Great Valley which stretches southward from Pennsylvania to Tennessee, and lies just west of the long line of the Blue Ridge. In Virginia, the central part of this long valley is drained by the James, the northern part by the Shenandoah, and the southern part by New River which flows westward into West Virginia.

The Great Valley of Virginia, shut in by mountains on both sides, is a fruitful region for grains and pasture-lands. Parts of it have a limestone foundation and are known as blue-grass belts. It is a hilly region, higher and cooler than that part of Virginia east of the mountains, and the farm products are more like those in Ohio and Pennsylvania and states farther north. An examination of the map will show a fine series of small cities along the course of the Great Valley in Virginia, as Winchester, Staunton, and Roanoke. Washington in his early days as a young surveyor explored a part of the Shenandoah Valley. In early history the people of Virginia passed down to the settlement of Tennessee through the Great Valley. During the Civil War several of the marches of the raiding armies and important battles, as that of Winchester, were witnessed in this mountain valley. It is but natural that this long valley should be the route followed by a railway, and on a map we may easily trace such a railway

from Harrisburg, Pennsylvania, to Chattanooga, Tennessee.

That part of the valley drained by the James River is interesting on account of the Natural Bridge and other

FIG. 29.

Natural Bridge, Virginia. This bridge is a part of an old cavern roof, the remainder having been removed by weathering.

scenery. Mineral springs, as the White Sulphur, are also much visited by tourists in this mountain region. The sources of the James are on the highest slopes of the great north mountain range where the valley sides are clothed

with a thick forest of evergreen and hard woods. The boundary between Virginia and West Virginia is an irregular line which follows the high ridges of these rough and forest-clad mountains. In early days these trackless and forbidding ridges almost shut out the Virginians from West Virginia and Kentucky. The New River, which is the upper part of the Great Kanawha, has cut its way through all these mountain barriers, and the Chesapeake and Ohio Railroad, following the valley and gorges of this stream and frequently tunnelling the cliffs, has been built through one of the most interesting and picturesque parts of the Alleghanies. The James River drains the eastern slopes of the mountains just opposite the Great Kanawha, and it is by following the gorges cut by these rivers that railroads are able to make their way across this series of mountain ridges, thus connecting the east with the west. The ridge, however, which separates the head waters of opposing streams, must be tunnelled.

In following the James River from its mouth at Old Point Comfort to its highest springs on the wooded mountain sides we are gradually climbing into a colder climate. At Fortress Monroe the winters are so mild that the live oak flourishes and holds its green leaves all the year. But on the crests of the Alleghanies the winters are cold and severe, and the trees are like those of Canada and the north. Virginia has thus a great variety of productions, of soil, of surface, and of climate.

In passing from the mouth of the James River westward to the mountains we pass across different belts as follows: First, Norfolk, representing the line of coast cities which are important seaports, as Baltimore, Wilmington, Charleston, Savannah, and Jacksonville. They

are connected not only by ocean-going vessels in the coastwise trade, but a line of inshore water traffic is traced from Delaware Bay by canal to the head of Chesapeake Bay, from Norfolk by canal to Albemarle Sound, and southward, behind the islands of Carolina, Georgia, and Florida. Florida has an inshore navigable water route for about six hundred miles. Second, all the way from Long Island Sound to southern Florida the fisheries and oyster beds abound in these inshore waters. Third, about Norfolk also we find the truck farming, which extends along the coast from New Jersey to Florida. Fourth, just back from the coast is the belt of turpentine forests, which occupy the sandy barrens of many of the southern states. A series of railroads also connects the seaport cities, one of which is called the Atlantic Coast Line, running mainly parallel with the shore line. Fifth, Richmond, on the fall line between tide-water and the uplands, represents a whole series of such cities as Raleigh, Columbia, Augusta, and Macon. These are also important railroad centres and lie usually at the head of river navigation. Sixth, the cities of the Piedmont belt, close to the foot-hills, are also connected by a long railway line, the Great Southern, passing through Charlottesville, Lynchburg, Danville, Greensboro, Charlotte, and Atlanta. Seventh, the Blue Ridge Mountain chain with its passes. Eighth, within the mountains, the cities of the Great Valley, from Harrisburg and Harper's Ferry to Knoxville and Chattanooga, are connected by a long line of railway. Thus it is seen that the chief railroad traffic routes of the whole Atlantic slope run at right angles to the river courses and follow these distinctly marked belts. In these respects the James is a type of Atlantic coast rivers.

A comparison of the James River with the Hudson in the following points will prove instructive and interesting: —

1. Cities and railroad centres at the mouth, harbors, and bays.

2. The tide-water region of each. The advantages for river commerce.

3. Richmond and Albany at the head of navigation.

4. The sources of the rivers in the mountains. The forests and scenery.

5. The points of historic interest along the Hudson and the James rivers.

6. The geological history, drowned river valleys, oyster beds, etc.

The comparison of the James River with the Potomac, Roanoke, and Santee as coastal streams will also be valuable.

A COAL-MINE

In many parts of Illinois the coal-beds lie under our feet. Many towns and cities in the central and southern part of the state have good coal-mines. So great is the value of the Illinois coal-fields that the black soil of the prairies is scarcely a better source of wealth than the coal-beds that lie from fifty to five hundred feet below the surface. About thirty-five thousand square miles, nearly two-thirds of the state, are underlaid by these rich coal deposits. The borings for coal in different counties reveal that sixteen distinct layers of coal have been found, ranging from one to nine feet in thickness. Sometimes three or four workable coal veins have been opened by a single boring, as at Bloomington and Springfield.

The coal-beds lie in layers or strata. Like the rock strata of sandstone and limestone, from which our building stone comes, the coal seams lie in horizontal layers between the layers of rock and sand. When first formed upon the surface, they were not coal-beds, but consisted of a thick matting of reeds, ferns, and tree trunks. As the land sunk, water flowed over these beds, collecting thick layers of mud, sand, and gravel over them, which afterward changed into rock. The layer of plants and trees changed into coal.

The three most common ways of entering a coal-bed are by drift, slope, and shaft. The drift is begun in a hillside where the coal seams crop out. After removing the

dirt and rubbish, a passage is worked into the coal. From fifteen to eighteen feet is the ordinary width to accommodate two tracks, and ten feet will readily accommodate one. Seven feet is an average height, but it may be higher. The floor of the drift must have a constant upward grade as it progresses inward, in order that the water may run out and that loaded cars may be hauled more easily. The mouth of the drift must be above the adjacent valley or stream, so that the water may be carried away. It is usually necessary to support the roof and sides of the drift by timbers, joined together in the form of a bent and placed more or less close to each other. The drift is the simplest and most economical way of making an entrance to a mine, as there is no expense for sinking the shaft, cutting through the rock, pumping out the water, or hoisting the coal. But most of the coal-beds lie below the level of the streams and valleys.

If there is an outcrop of coal on the tract to be mined, and the dip of the seam (downward into the hill) is not more than twenty degrees, it is usually advisable to enter the mine by means of a slope. This is a passage which, beginning at the outcrop, follows the coal seam down until the necessary depth is reached. It is driven in the coal. The slope in some of the coal-fields is driven down about three hundred feet, at which point gangways are opened out to right and left, and chambers extended from them back toward the surface.

In early mining operations, the drift and the slope were much used in entering the coal-fields, as they were easier and cheaper, but most of the beds capable of being entered in this way have been mined out, and the coal seam is now usually reached by a shaft.

The shaft is like a great well sunk straight into the earth. Before beginning a shaft, it is desirable to locate the coal-bed and its slant as nearly as possible. This is done by studying the rocks of the surrounding country and by boring. Since a shaft costs frequently from

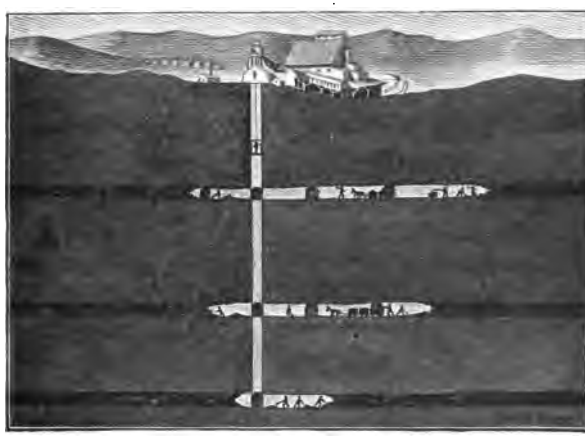


FIG. 30.

Diagram to illustrate how coal is dug out of the beds in tunnels, and raised to the surface through shafts.

$25,000 to $100,000, it is desirable to make no mistakes in its location.

In beginning to open the shaft, a rectangular hole is dug from four to eight feet wider and longer than the proposed dimensions of the shaft, and the soil and loose stones are thrown out from large areas until the bed-rock is reached.

From this rock a cribbing of solid timber twelve inches thick is built up to the surface, on the four sides of the opening, to prevent the earth from caving in. Sometimes

heavy walls of masonry instead of the timber cribbing are built. When this has been accomplished, sinking through the rocks goes on by the ordinary process of blasting, plumb-lines being held at the corners of the shaft to keep the opening vertical.

The horizontal dimensions of the modern shaft average about twelve feet in width by thirty in length. The space is divided crosswise down the entire depth of the shaft into compartments, of which there are usually four. The first of the compartments is the pump-way, space devoted to pipes, pump-rods, and other appliances connected with the pumping system. To this, six feet in breadth are allowed. Then comes in succession the two carriage ways, each of which may be seven feet wide, and finally the air-passage, by which the foul air is exhausted from the mine, and to which ten feet are appropriated. The air-passage is boarded up and made as nearly as possible air-tight. The carriage in each of the carriage passages is raised and lowered by a wire cable, fastened to the middle of the cross-beam above. The cars of coal, as well as the men, are raised and lowered by means of these carriages, and great care for safety is taken in their construction and use.

The safety carriage is now generally in use in at least one of the hoisting passages. It is built of wrought iron instead of wood ; it has a bonnet or roof to protect against falling bodies; and it has safety clutches or dogs to stop the carriage and hold it in place in case of accident by breakage of the rope or machinery.

It costs usually from $300 to $500 a yard to sink a shaft with four such compartments, and sometimes a shaft that has been begun at a great expense may have to be

abandoned because of the great rush of water or of a bed of quicksand.

It is usually intended to sink the shaft at such a point that its foot will strike the lowest part of the coal-bed, which usually slopes. In working out into the coal area from the foot of the shaft, the slope will always be upward and the water will flow toward the foot of the shaft whence it can be pumped out. Usually a sort of water basin is excavated on the lower side near the foot of the shaft. In this cistern the water collects from all parts of the mine and an engine above pumps it through the pipes of the water-passage and discharges it above ground. Sometimes it takes a powerful engine constantly pumping to keep down the level of the water in the mine.

From the first it is necessary to secure a good *circulation* of air through the passages and chambers, so that foul air and gases produced in the mine can be constantly removed. From the foot of the shaft, on one side, a passage is cut through the coal from ten to fourteen feet wide. This is one of the main gangways. After reaching a short distance, a narrow passage, six feet wide, is cut at right angles to the gangway to a distance of from fifteen to thirty feet. At the extremity of this cross-heading a passage is run parallel to the gangway. After running the gangway and this last air-passage parallel for a distance of sixty or more feet, they are connected again by a cross-heading. It is evident now that we have a square enclosed by tunnels, namely by the gangway, the air-passage, and the two cross-headings. It is possible, therefore, to cause the fresh air to pass round this square and to return, collecting the gases and other impurities on the way through the passage and driving them back on its return

to the foot of the shaft where they are all carried up the air-passage to the open day. By means of a wooden partition in the gangway, and an extra air-passage, the foul air on its return is kept separate from the fresh air that enters the mine from the main shaft. This current of air is kept in motion by a fan driven by a steam-engine. It stands not far from the foot of the shaft and sends the foul air in a strong current up the shaft. The fresh air passes down the carriage or elevator passage to make good this deficiency. In this way a constant circulation is kept up in the mine. This constant stream of fresh air is necessary to the miners because the fire-damp and other foul and explosive gases collect rapidly in the mine, and would soon make it not only dangerous but impossible to work longer.

As soon as proper arrangements have been made for the circulation of air and for pumping out the water that constantly accumulates, the regular work of mining the coal can be begun. The coal between the main gangway and the air-passage is left standing as a support to the roof of the mine. The miners begin now to open a way from the air-passage outward, and after a narrow opening, wide enough for a coal car, has been cut to a distance of fifteen feet, the miner begins to mine away the coal and form a chamber from twenty-four to thirty-six feet wide ; a track is also laid from the chamber to the foot of the shaft. The coal is removed by the car on the track and carried to the mouth of the shaft to be raised above ground. A second chamber parallel to the first is then dug, connecting in the same manner with the air-passage. A partition of coal from fourteen to twenty feet thick separates the two chambers. In order to secure a circulation of air through

these chambers a passage is cut through this partition and the air-passage outside of the chambers is closed up by a wooden partition so that the air in its circuit passes through the chambers. The chambers are now extended deeper into the vein of coal; at every twenty-four or twenty-six feet a new air-passage is opened up, while the old one is closed, thus causing the air to circulate close up to where the men are working. Several of these chambers are carried up parallel to each other into the vein of coal at the same time, and as the coal is dug away it is removed in cars to the mouth of the shaft, while the air is kept fresh in them all.

FIG. 31.

A view in a coal-mine in Pennsylvania.

The number of persons employed in a single mine varies from a dozen in the newest and smaller mines to seven or eight hundred in the largest and busiest. There are generally four workmen, two miners, and two laborers employed in each chamber. The miners are employed by the coal company and the laborers are employed by the miners. The miners belong to the aristocracy of the underground workers.

After working a few feet into the coal, props usually become necessary to prevent the roof from falling. The hard-wood props used are nine inches in diameter. They are furnished in large quantities by the mining companies. The miner as he advances into the coal sets up these props where there seems danger of the roof falling and makes them firm against the ceiling by driving a flat wedge between the top of the prop and the coal. This flat wedge also remains and causes the prop to hold up a larger section of the roof of the mine.

Sometimes the props are not so much needed. The chief work of the miner is to blast out the coal from the face of the chamber and set up the props. When ready to begin blasting he takes up the drill, an iron rod five and a half feet long and more than an inch in diameter. It is sharp like a chisel at the point. With quick, sharp strokes and by turning the drill in his hands, the miner works a hole into the face of the coal about four and a half feet deep. After this hole has been cleaned out, a cartridge containing black powder is pushed into the farthest extremity of the hole. Fine moist dust is then pressed against the cartridge, leaving a small hole from which a fuse may reach the cartridge. The fuse is then laid in this hole and lighted. The miner cries "Fire," and the men hasten to get behind some pillar or wall of coal. The fuse burns slowly and the men have plenty of time to escape from danger. The explosion throws out a considerable quantity of coal into the chamber in large and small pieces. Soon the miner is at work boring another hole for blasting. But the boring is often very difficult and laborious; sometimes the miner works on his hands and knees, sometimes lying on his back on the wet floor, sometimes holding the drill high above his head and

sometimes he uses a machine drill worked by a crank. When the miner has blasted down the coal and set up the props, his day's work is done. He enters the mine at seven or before, and often has his day's work done by ten or eleven o'clock. The laborer has to break up the chunks of coal, load the cars, move them to the gangway, and keep the chamber clean for work. His day's work lasts longer than the miner's, but he hopes some day to be a miner himself.

Boys are often employed in the mines to drive the mules back and forth from the foot of the shaft with the trains of cars. Sometimes they open and close the doors in the air-passages. In Pennsylvania they are prohibited from working in the mines under fourteen years of age.

The dangers connected with mining are numerous, and the law requires that many precautions shall be taken to prevent accident and death. Some of the chief dangers are from caving in of the roof, from explosions of fire-damp, from deadly gases, from flooding the mines with water, from fires in the shaft or in the tunnels. Besides these, there is danger from the falling of cars and other objects in the shaft, from collisions between the cars, etc. One of the most common dangers is from the caving in of the roof; in spite of the care taken to prop up the roof with heavy posts, the roof caves in, breaking the posts and crushing the men to death. It happens sometimes very suddenly, and in some cases several acres of tunnels have fallen at once, burying many men. At times the men can tell by the creaking noises that the roof is about to fall and can save themselves.

Fire-damp and other inflammable gases are constantly oozing from the coal in some deep mines, and unless the

current of air is strong, they collect and are ignited by a lamp, causing an explosion. As these burning gases, being lighter than the air, lie along the roof of the mine, the miner throws himself with his face to the ground and his arms around his head to escape the heat above. But as soon as the gases have burned out, he rises quickly and escapes, as the poisonous after-damp, or smoke from the fire, settles to the ground, and a single breath of this will suffocate the miner.

In some cases a flood of water and mud has been known to break through the wall of the mine and drown or bury the men suddenly. This is especially apt to be the case when a new mine is being worked near an old, abandoned one, in which great quantities of water have been allowed to collect.

Fires have sometimes broken out in mines, resulting in the death of hundreds of workmen. Men are suffocated by the smoke, heat, and gases produced. In a few cases the buildings over the shaft have first taken fire and then the woodwork in the shaft, and gradually the mine below. Of course the air currents were stopped and the men below suffocated.[1]

The machinery connected with a large coal-mine is varied and extensive. Not far from the entrance to the shaft are engine-houses, for hoisting the carriages, coal, men, etc., also the engine for pumping the water from the mine. The elevators or carriages have tracks on the floor

[1] In some states laws have been passed by the state legislatures forbidding wooden buildings over the mouths of shafts. They are apt to catch on fire and then set the mine on fire, producing great disasters. In some states a second shaft is also required, through which miners may escape in case of fire.

upon which the loaded coal-cars can be run. Mules are used in the gangways and air-passages for hauling the cars to and from the shaft. Sometimes a stable is fitted up in the mine and the mules are kept below. Wooden tracks are laid for the cars. Air-boxes are laid in places for conducting fresh air. Besides these things there are tools, powder, lamps, and oil needed in mining.

Above ground in the anthracite coal regions is the large building known as the *breaker*, where the large chunks of coal are broken between great revolving wheels or cylinders with pointed iron teeth. The broken coal then passes into wire screens with small meshes, through which the fine pieces drop and the coarser pieces pass on to coarser screens, till at length the larger pieces are dropped through. In this way the coal is separated into several varieties according to the size of the lump, such as lump coal, egg coal, nut coal, etc. In the breakers boys are also employed to sit in the troughs and chutes to pick out the pieces of slate and stone and throw them to one side.

"The first visit to a mine[1] is full of strange sights and sounds. The first noteworthy thing is the descent on the cage or carriage. Under the care of the mine foreman, we were allowed to go down. From the head to the foot of every shaft a speaking-tube extends, and signalling apparatus, which is continued to the engine-room. At the head of the shaft is stationed a head-man and at the foot of the shaft a foot-man, whose assistants aid in pushing the cars on and off the carriages. The foot-man is notified of your coming as you take your place in the empty safety carriage. It swings lightly as you step on it realizing

[1] Greene's "Coal and Coal Mines," Houghton, Mifflin, & Co.

that besides the few inches of planking under your feet there is nothing between you and the floor of the mine five hundred feet or more below you. When all is ready the foreman cries, 'Slack off!' the carriage is slightly raised, and the descent begins. If the carriage goes down as rapidly as usual, your first sensation will be that of falling, and your first impulse will be to grasp something above you. Then it will seem as if the motion were reversed, and there will be an alternation of these sensations during the minute or two occupied in the descent. Finally, the motion of the carriage becomes suddenly slower and you feel it strike gently at the bottom of the shaft.

"As you step into the darkness nothing is visible to you except the shifting flames of the workmen's lamps. After a few minutes you are able to distinguish objects that are ten or fifteen feet away. You can see through the murky atmosphere the rough walls of the solid coal about you, the flat, black, moist roof overhead, and the mine car track at your feet. The carriages appear and disappear and are loaded and unloaded at the foot of the shaft, while the passage at one side of which you sit is filled with mine cars, mules, and miner boys in apparently inextricable confusion. The body of a mule looms up suddenly in front of you, you catch a glimpse of a boy hurrying by you, a swarthy face lighted up by the flame of a lamp gleams out of the darkness, but the body that belongs to it is in deep shadow; you cannot see it.

"Bare, brawny arms become visible and are withdrawn, men's voices sound strange, there is a constant rumbling of cars, a regular clicking sound as the carriage stops and starts, incessant shouting of the boys; somewhere the sound of falling water. Such are the sights and sounds at

the shaft's foot. If now you pass in along the gangway, throwing the light to your feet to see, there will be a sense of confinement in the narrow passage with its low roof and close, black walls. Occasionally you will have to crowd against the rib to let a trip of mine cars pass by, drawn by a smoking mule, in charge of a boy with soiled face and greasy clothes. You are lucky if you are in a mine where the roof is so high that you need not bend over as you walk. The men whom you meet have little lamps on their caps, smoking and flaming in the strong air current. Everything is black and dingy. Now you come to a door on the upper side of the gangway. A small boy jumps up from a bench and pulls the door open for the party to pass through. As it closes behind you the strong current nearly extinguishes your lamp. You walk along the air-way for a little distance and then you come to the foot of the chamber. Up somewhere in the darkness, apparently far away, you see four lights twinkling; they appear and disappear, they waver from side to side, they bob up and down, till you wonder what strange contortions the people who carry them must be going through to give them such erratic movements. By and by there is a cry of 'Fire!' It is repeated several times. Three lights move suddenly down the chamber and disappear, then the fourth one approaches and disappears also. The men who carry them have hidden behind pillars. You wait, one, two, three minutes, looking into the darkness. Then there is a sudden wavelike movement in the air; it strikes your face; you feel it in your ears; the flame of your lamp is blown aside. Immediately there is a sound of explosion and the crash of falling blocks of coal. Soon the lights reappear, all four of them, and

advance toward the face. In a minute they are swallowed up in the powder smoke that has rolled out from the blast. But when the smoke has reached and passed you the air is clear again, and the lights twinkle and dance as merrily as they did before the blast was fired. Now you go up the chamber, being careful not to stumble over the high caps into the notches with which the wooden rails of the track are lined. On one side is a wall built up with pieces of slate and the refuse of the mine; on the other you can reach out and touch the heavy wooden props that support the roof. Up at the face there is a scene of great activity. Bare-armed men, without coat or vest, are working with bar and pick and shovel, moving the fallen coal from the face, breaking it, loading it into the mine car which stands near by. The miners are at the face prying down loose pieces of coal. One takes his lamp and flashes its light along the black, broken, shiny surface, deciding upon the best point to begin the next drill hole, and giving quick orders to the laborers. He takes up his drill, balances it in his hand, strikes a certain point on the surface with it, turning it slightly at each stroke. He has taken his position lying on his side perhaps, and then begins the regular tap, tap of the drill into the coal. The laborers, having loaded the mine car, remove the block from the wheel, and now, grasping the end of it firmly, hold back on it as it moves by gravity down the chamber to the gangway. You may follow it out, watch the driver boy as he attaches it to his trip, and go with him to the foot of the shaft.

"You have seen something of the ceaseless activity and noise of a mine when hundreds of men are at work. But when you are alone in such a place, or in an abandoned mine, the stillness is profound like nothing above ground."

The above description applies especially to the anthracite coal region, where the coal is got out by blasting, and large buildings above ground, called *breakers*, prepare the coal by crushing and separating it for the market.

The bituminous or soft coal fields are worked upon a somewhat different plan. The seams of coal do not lie so deep, drifts are much more used, and instead of drilling holes into the coal, grooves are cut, and then by prying or blasting, the coal is got free. The soft-coal beds are more level and uniform, and for this reason more easily worked.

If we turn to the uses to which coal is put after reaching the surface, we shall begin to see the importance of this business. The mines are usually along railroad lines or rivers, which distribute the coal to those districts where it is most used. The railroads themselves consume a great deal in their locomotive engines for freight and passenger service. The railroad machine shops depend upon coal for putting their machinery in motion, for their furnaces, forges, stationary engines, etc. In our towns and cities the multitude of factories depend almost entirely upon coal, as in car shops, rolling-mills, glass works, foundries, factories for the manufacture of carriages, furniture, boots and shoes, cotton and woollen goods, paper, printing-presses, farming implements, etc. Except when water-power is used in flour-mills, woollen-mills, etc., most of our factories are run by steam-engines. Coal is also of importance in most households for heating purposes. Dwellings, schoolhouses, and buildings of all sorts are heated generally by the use of coal. It is clear, then, that coal mining is one of those occupations that is necessary to the success of nearly all other kinds of business, and to the comfort of most people in their homes. The men who

are digging in the dark earth far below the surface are supplying all other classes of people with the means of doing business and of living in comfort.

That the prairie states of the west be well supplied with coal-fields is of special importance. Without these underground riches, the states of Illinois and Iowa, for example, could not settle up so rapidly ; railroads could not have been built and operated, and farmers could not

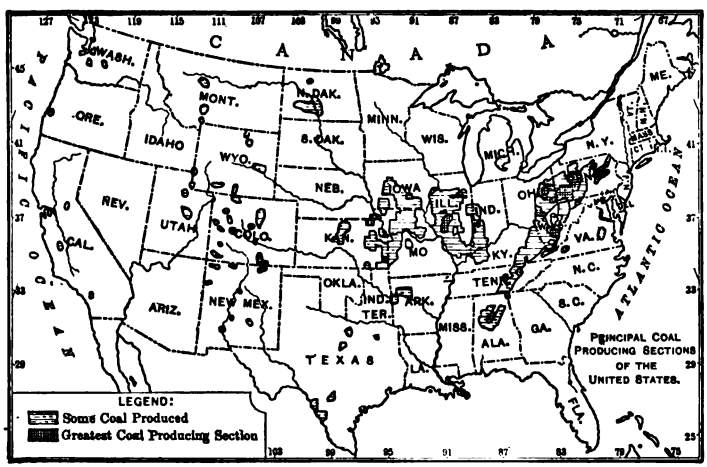


FIG. 32.

ship the rich products of the prairies to the east and receive in return the manufactures and other exchanges of that section.

Let us observe the location of the chief coal-fields. In Illinois they extend over about two-thirds of the state south of a line drawn from Rock Island to Joliet. The coal lies at different depths and in separate strata. In a number of places the coal veins crop out along the banks

of creeks and rivers, as at Danville, Peoria, etc., but usually vertical shafts are sunk from a hundred to five or six hundred feet deep. In the south-central part of the state some of the coal-beds lie more than a thousand feet below the surface, but only the upper veins, nearer the surface, are yet worked. Many thousands of men are employed in the coal mines of Illinois. In 1889, 11,597,963 tons of coal were mined in Illinois, which stands second only to Pennsylvania in the amount of coal produced.

Several of the neighboring states also have extensive coal areas. A strip along the southwestern part of Indiana yields much coal. This is a continuation of the Illinois field, and extends south through Kentucky into Tennessee. Altogether these four states have about sixty thousand square miles of coal area.

Another extensive coal-field, larger still, extends through central and western Iowa, into Missouri, eastern Nebraska, Kansas, Arkansas, and Indian Territory. The whole western slope of the Alleghany Mountains also has rich coal deposits, as in Pennsylvania, West Virginia, Ohio, Kentucky, Tennessee, and Alabama. In Michigan, Colorado, and Texas, there are also smaller coal areas, besides those east of the Alleghanies and west of the Rockies. (In order to fix these coal-fields definitely, consult the map on the preceding page, Fig. 32; also the maps in Trotter's "Geography of Commerce," p. 78, and Frye's "Complete Geography," p. 137.) Locate the coal-fields by states on a map and draw the map.

Notice, on a large map of the United States, the cities which lie in or near the coal-fields, and see if they have any relation to the shipping of coal, as Pittsburg, Philadelphia, Chicago, St. Louis, Cleveland, Buffalo, and others.

Observe, also, any navigable rivers which may be useful in distributing this coal. Let teacher and pupils draw a map of the United States, locating the coal areas by states; also the cities and rivers above suggested.

The careful and detailed description thus far given of the business of coal mining, is designed to bring out clearly its importance as related to commerce, manufacturing, and domestic use, so that when we touch upon coal mining and the other occupations to which it is related, we shall at once see their significance.

Later in the study of other kinds of mining operations, as in lead, silver, zinc, and gold, the knowledge gained from coal-mines will be of much service, and a comparison with coal-mines to point out differences and similar methods will be helpful. The knowledge gained from a full study of a single typical coal-mine in Pennsylvania and in the Mississippi Valley will help not only in understanding coal-mines in other parts of the United States and in the world, but also for interpreting all kinds of mining operations.

NOTE.—Most of the above facts are obtained from Greene's "Coal and Coal Mines," published by Houghton, Mifflin & Co.

ORANGE GROVES IN FLORIDA

FLORIDA for many years was famous for the production of sweet and juicy oranges. After the great freeze of 1895, which destroyed so many of the groves, oranges had to be sought elsewhere. But the production is gradually increasing and Florida is again coming into the market as a large orange producer.

Up to 1895 the northern part of Florida abounded in oranges and the northern people who had wintered in the south were accustomed to tell provoking stories of the sweet juiciness and cheap abundance of the oranges among these semi-tropical orange groves.

In February, 1895, the warm spring weather had coaxed the orange groves into full spring growth. The heavy crop of the previous season was still hanging in golden profusion on the trees, the buds were ready to burst with the fragrant blossoms and the trees were full of sap. Suddenly one afternoon, in the midst of this balmy warmth, the cold wave of a northern blizzard swept down over all northern Florida, the thermometer quickly dropped far below the freezing-point, before morning the trees were covered with an icy sleet, and in one night the whole world had changed color. Hundreds of orange groves were completely ruined; not only the rich harvest hanging on the trees was blackened and poisoned, but the trees were frozen to the ground, dead as old stumps. The bark of the trees was split from top to bottom and complete deso-

lation and rottenness soon took the place of the prevailing bounty of a few hours before. In all northern Florida scarcely a tree survived this freezing blast. It would take from ten to thirty years to bring to perfection such a stand of orange trees as were found in the groves before the freeze.

The overwhelming nature of this disaster to the people of Florida is better understood when we recall the fact that orange groves were almost the sole productive wealth of the people. They raised almost nothing else; they had very few gardens, or factories, or industries of any kind. For many years the people had lived so easily and comfortably upon the products of their orange groves that they had taken no trouble to raise potatoes, or corn, or onions, or other vegetables, or even other kinds of fruit. The owners of good groves felt very secure, and were accustomed to buy all their goods from the north and often to mortgage the next crop of oranges for payment. After the freeze many families of wealth and comfort had absolutely nothing to live upon. A man who the day before was supposedly worth $50,000, as based upon his orange grove and crop, was now not able to raise a dollar. Orange land worth $1000 an acre before the freeze was now estimated at not more than ten dollars an acre. It has been said that northern Florida suffered as much, relatively, from this disastrous freeze as Chicago did in the great fire. Undoubtedly millions of dollars' worth of property had been destroyed. Many people were suddenly brought into the greatest straits to make a bare living.

At Palatka, Florida, fifty miles south of Jacksonville on the St. Johns River, was found, before the freeze, one of the great centres of orange shipment. Oranges were

hauled in wagon loads, or brought in boat loads into the packing houses along the river docks at Palatka, and loaded upon steamboats for the northern market. For miles around the country was rich in orange groves, from ten to forty years old. All along the river also, on lands that were not too swampy, were great orange plantations with fine southern houses and full equipment of barns, sheds, and packing houses. These places had their private wharves where the crop was loaded upon steamboats. The great freeze for the time being annihilated these orange groves and it is only in a few cases, and gradually, that groves were replanted and developed.

About three years after the fruit freeze, when many people had gotten new orange groves started and were looking forward to an early renewal of their profits from the orange crop, a second destructive freeze came which paralyzed the hopes of the orange men.

As a result of these heavy misfortunes, many people began to turn their attention to other kinds of agriculture, gardening, and fruit growing. Orchards of pears and peaches were planted, gardens of lettuce, cabbages, celery, tomatoes, and other vegetables were cultivated, and strawberries were raised for the home and northern market. Some of the swamp lands underlaid with clay when well fertilized have been found very prolific in potato crops. Tens of thousands of bushels of early potatoes are now shipped each year to New York and other northern cities because Florida can have them ready for market by the middle of April, earlier than any other state. Truck gardening for the northern market is now quite common in Florida. Many acres are given to tomato fields and celery. The pineapple has also been extensively raised,

generally in covered pineries and in close connection with orange groves. Groves of pecan trees were set out. The cultivation of grapes for the manufacture of wine was developed. The guava, the persimmon, and other fruits of the semi-tropical regions were tried also.

Many other kinds of business have also been developed, such as cattle raising in the swamp-lands and woods; regular farming for corn and grain, cotton and tobacco; turpentining in the pine woods; and saw-mills among the pine uplands and cypress swamps.

Besides this the great influx of northern visitors in the winter time, with plenty of money and enterprise, has been of great value to the state and a help to its development. Along the coast and on inland rivers and lakes have been built many beautiful hotels and health resorts where thousands of northern visitors spend their time and money during the winter and early spring months.

The orange business, also, is recovering rapidly from its almost complete ruin. The region of orange cultivation has extended much farther south, beyond the reach of the occasional frosts and cold of the northern part of the state. From along the Indian River, on the southeast coast during recent winters many excellent oranges have been received. At Orlando, a hundred and fifty miles south of Jacksonville, the orange groves are looking well and have already borne a good crop. From Palatka southward there are many promising groves. Along the gulf coast below Tampa orange groves are also becoming numerous and productive.

In the more northern and exposed sections of Florida the ways devised for protecting young orange trees from occasional frosts and harder freezes are interesting. When

first planted, for three or four years, the sandy soil is shovelled up three or four feet high around the young trees so as to cover them almost completely. In the spring the dirt is taken away. As the trees grow larger, tents are placed over them. In many cases a large circular tent, made to open and close around a large hoop, with a cap at the top, is made to circle each tree when a cold snap threatens. On frosty nights in winter the tent is closed, a lighted lamp placed within it, and the lower edges covered with dirt to close it up more tightly. The weather conditions and weather reports are carefully watched and full provision is made for sudden cold snaps. As the tree grows larger, a still larger tent must be used. Sometimes each tree is surrounded with a square boxing of boards and lamps are used in a similar manner.

A grove is also often protected against cold by heaping up, at intervals among the trees, small piles of cord-wood, which, on an unusually cold night, perhaps two or three times in the winter, are fired, and the heat and smoke protect the trees from the frost. A grove is often protected in this way from a frost that would destroy the crop or injure the trees.

A still more expensive mode of protecting a large grove is to surround it with a high stockade or tight board fence, twelve or fifteen feet high. A field of ten acres is fenced in this way, and by means of tall posts arranged in rows across the field a board or canvass cover can be slid across so as to completely cover the whole field. Such a structure is called an orange shed and costs about $1000 an acre for its construction. Near De Land, Florida, one owner has several such sheds covering in all about sixty-five acres of well-developed orange groves.

To keep such a grove warm in cold weather, salamanders or sheet-iron stoves, open at the top and full of coke, are set at intervals under the shed and fired.

It has been fortunate for Florida that many wealthy people from the north own orange groves in the south. They have been willing to spend much money in experiments in various ways for protecting their groves and this has done much to keep up this great industry. After their immense losses in the two freezes, the smaller orange farmers in Florida could not afford the money for such expensive and doubtful experiments.

Even under ordinary conditions with good weather an orange grove requires much care. The young trees secured from an orange nursery must be protected from too much heat, the ground kept in a state of cultivation, and a rich supply of fertilizer applied each year to the roots of the young trees. The trees do not begin to bear much until about five years old, and not till about ten years are they large enough to bear abundantly. They are known to continue bearing to the age of fifty years.

The fragrant white blossoms of the orange appear in the latter part of February and in March, and soon after the little green oranges begin to form. They grow during the summer and fall and begin to ripen during November, but they remain hanging all winter on the trees unless plucked. Accordingly it is not uncommon to see ripe yellow oranges, young green fruit, and blossoms on a tree at the same time.

In order to avoid the winter frosts, the crop now is generally picked, in open groves, before Christmas or about that time. They are carefully packed in boxes

and shipped to northern markets where their superior flavor insures them a good price.

Several varieties of orange are cultivated, such as russet, navel, king, and the common sorts. The tangerine, the grape-fruit, and the lemon are cultivated alongside the oranges in the protected groves. The huge pome of the grape-fruit has come into much favor of late years though formerly little regarded. It is often as large as a half-gallon pail.

In spite of the destructive frosts of a few years ago, Florida oranges are now in the market, and a steamboat trip along the St. Johns River will bring into delightful view many a beautiful grove along the winding shores. From the shores, also, of the numerous lakes which beautify the landscape of Florida, the green, flourishing groves are seen.

One result of the distressing frosts, which is of the greatest importance, is the great variety of agricultural and other industries which have since sprung up, revealing many valuable resources which were formerly little developed or thought of. A like disaster can hardly overtake the state again since there are now so many profitable industries which are not affected by the frost.

On the opposite side of the continent in southwestern California is a similar orange-producing region which is the chief competitor of Florida in the markets of the United States.

In recent years, California oranges have found their way all over the United States, even into Florida. It is claimed that Florida oranges are juicier and richer in flavor, but the California crop because of its abundance and reliability has largely secured the market.

It is probable that with the rapid southward extension of orange culture along the Atlantic and Gulf coasts of Florida, the quantity of fruit raised will enable her to regain her place in the orange market. The great extension of pineapple culture and that of grape-fruit, together with the rapidly growing truck farming in central and southern Florida and the development of important railroads throughout this region are bringing all these products into easy relation to the northern and eastern markets.

THE ILLINOIS RIVER

THROUGH the central portion of Illinois reaches the crooked valley of a river of considerable size. Its headwaters are close to Lake Michigan, both on the southeast and on the west. The Indians and white men who first explored this region, carried their boats across the portage at South Bend to the Kankakee, or at Chicago to the Des Plaines. The Illinois is five hundred miles long, and for two hundred and forty-five miles, or nearly half that distance, is regularly used by steamboats for commerce. At some seasons it is now possible to launch a canoe in the Des Plaines, not far from Chicago, and make a journey by water to the mouth of the Illinois. But while the general slope of the country is the same now as then, while the same hills and bluffs are seen along the streams, everything else appears greatly changed since the days of Marquette and La Salle. The valley of the Des Plaines, a mile wide in places, is bordered with low hills, and as we move south toward Joliet, shows some curious sights. Along the east side canal-boats are seen gliding by, loaded with stone or grain, coal or lumber. Sometimes the boats are drawn by mules, and again a little steam-engine is seen puffing in one end of the boat. From time to time the canal widens, and several canal-boats are seen lying at anchor just above a lock, through which the boats are let down to a lower level, if they are passing toward Joliet; but they may be as easily raised if the boat is headed for Chicago. The lock consists of heavy side walls of ma-

sonry, with stout, double doors or gates at each end. The boat is let into the lock by opening the doors at one end. If it is headed down the canal the lower gates are then opened, or partly so, till the water glides out, leaving the water-level in the lock the same as in the canal below. The water in the canal flows steadily from Chicago River toward Joliet, carrying much of the sewage of the city into the Illinois. Chicago River has been deepened by digging and dredging. As the upper end of the canal is still lower than the level of the river, the water flows from the river into the canal and thus draws a current from Lake Michigan. At the present time we may see where the work has been completed of excavating a much deeper and wider canal, which may serve as a means of drainage and of water-power to the city of Chicago. The machines employed and the great heaps of earth and rock thrown out show how great this undertaking has been. In many places this new drainage canal is excavated through solid rock thirty feet deep and 160 feet wide at the bottom. The whole cost is estimated at $21,000,000. We soon discover that the old canal, as well as the new one, is dug for a long distance in the solid rock, which here lies close to the surface. In fact, for fifteen or twenty miles north of Joliet, the whole eastern side of the valley seems to be one long row of rock quarries, where the limestone strata, lying in regular layers, are quarried and blasted out, sawed, and placed upon canal-boats or railroad cars, to be shipped to Chicago, where vast quantities are needed for the foundations of buildings. The Chicago and Alton Railroad also runs along this valley with the low hills and quarries on one side and the canal and river on the other. The Chicago and Rock Island Road passes along

the same valley. Just before reaching Joliet, our attention is attracted by a large stone structure, which has the appearance of a grand old castle, with high walls and towers on the corners. It is the state penitentiary, where hundreds of criminals are kept, and the rock quarries not only furnish materials for its construction but also labor to many of the convicts, who are employed in the quarries.

At Joliet we may see great steel works, blast furnaces, and mills, and at this place the canal is carried across the river by means of a dam, which raises the water to the level of the canal, so as to let the canal-boats cross. From this place the canal follows the north bank of the Des Plaines and of the Illinois, till at Peru it enters the river. About fifteen or twenty miles southwest of Joliet the Des Plaines joins the Illinois River, which is formed by the union of the Kankakee and Des Plaines.

At most of the large towns upon the Kankakee and upon the Des Plaines we shall find dams in the river which are used to supply water-power to mills and factories, as at Wilmington, Kankakee, and Joliet. The Fox River, also, which joins the Illinois from the north, has several large towns like Aurora and Elgin which have good water-power. These smaller streams, therefore, while they are not large enough for steamboats, are still of much service both for drainage and for water-power.

From the point where the two rivers unite to form the Illinois, the latter becomes an interesting river. The bluffs are high in places and partly wooded. The valley is broad and the river winds in many curves through the great trough which has been cut down into the level prairies by the floods of water that have swept through

this channel in past ages. Geologists tell us that the waters of Lake Michigan once found their outlet to the Mississippi through the great trough of the Illinois Valley. The old channel connecting the lake with the river has been found south of Chicago, but was choked up and filled long ago by gravel and drift.

As our boat glides along the current between the wooded bluffs toward La Salle, a number of interesting spots are passed. At Ottawa the Fox River comes in from the north, and over it the canal is carried on a stone bridge or aqueduct. It looks much like a stone railroad bridge with great, heavy arches to support the weight of water passing through the canal. All the streams that come down to the Illinois from the north pass under the canal in this way. The canal, of course, follows the level valley between the river and the bluffs. A railroad, the Rock Island, follows the same valley close to the canal and river. This broad valley is very favorable to commerce both by water and by rail. Swift-moving railroad trains and slow-moving canal-boats add much to the life of this region. Near Utica, on the north side of the river, is the wide meadow where the great village of the Illinois Indians once stood, and near which Tonty tried to prevent a battle between the Iroquois and Illinois tribes. On the south side is the steep front of Starved Rock, on the top of which Tonty built Fort St. Louis. Afterward, according to tradition, the last of the Illinois were starved to death on the summit of this bluff. At its base flows the Illinois River, at the rear is a steep ascent, and the broad valley, seen from its top, with the winding current, is very picturesque. On the north side of the river is Buffalo Rock, also famous history.

FIG. 33.

Starved Rock on the Illinois River.

FIG. 34.

Deer Park, near Starved Rock.

A little west of Starved Rock the Vermilion River enters the Illinois Valley from the south, itself coming through a deep, narrow valley, along which is found some picturesque scenery. Deer Park, which opens into this stream, is a narrow, rocky cañon, with steep sides sixty feet high, which are thick with woods, so that the narrow gorge is cool and shady even on hot summer days. At the upper end of the winding cañon is a semicircle of steep rock, over which a little stream tumbles and then flows down through the cañon. Deer Park is only a few miles from Starved Rock, and this whole region is interesting to the tourist.

Just before reaching La Salle, our boat passes under the high bridge of the Illinois Central Railroad. At La Salle are great zinc works, which can be seen from the river. At Peru, a few miles to the west, the Illinois and Michigan Canal enters the river, after a journey of ninety-eight miles from Chicago. From this point on the river is deep enough for canal-boats and small steamers.

We may now abandon our canoe and take up comfortable quarters on a steamboat for the rest of the journey. Above this the river is too shallow for steamers in summer time. In fact, a dam in the river at Henry, twenty miles below Peru, raises the water six or eight feet and deepens the current twenty miles up-stream as far as Peru. On the west side of the dam at Henry is a lock, which enables boats to pass by the dam. The dam and lock at Henry, by means of which the water is deepened above and boats allowed to pass through, belong to what is called the system of slack-water navigation.[1]

[1] The new Drainage Canal has so much increased the quantity of water in the Illinois River that the dams at Henry and below are not now so much needed as formerly.

Between Peru and Henry the Illinois River makes a grand sweep to the south. The valley is very broad, two or three miles in places, and the bluffs sometimes two hundred feet high. The road leading from the prairies to the valley below follows some ravine, and must descend a long, steep hill before reaching the bottom-lands. The bottom-lands are often low and marshy, sometimes covered with swamp-growing trees. Some of the bottom-lands are above the water-level and make rich corn-fields. The soil in many of these bottoms is very deep and rich (sometimes fifty feet), and very heavy crops are raised. But in wet seasons the crop may be wholly destroyed by the floods. Among the bottom-lands are found shallow bayous and lakes, which are ancient channels of the river, now cut off and partly filled up. In the season of duck hunting, thousands of wild duck feed among the swamps and bayous, and the sound of the sportsman's gun may be heard at all hours of the day echoing between distant bluffs of the valley.

Below Henry the river winds through a broad valley with lower and more sloping bluffs. After passing a number of wooded islands below Lacon, the river widens into a long, shallow lake which reaches to Peoria. Peoria, which is near the site of the old Indian village, lies upon a sloping plain which rises gradually a mile back from the river to the foot of high, wooded bluffs. The big breweries, distilleries, and glucose factories, for which Peoria is noted, lie mostly near the bank of the river. The best business streets are a few blocks back from the river and higher up on the slope, and many of the finer residences have been lately built along the upper edge of the bluffs and overlooking the valley and lake for miles.

Just below Peoria an important railroad bridge spans the

river, and at several other towns below there are railroad bridges, as at Pekin, Havana, and two or three smaller places. Below Pekin the railroads do not follow the valley, but cross it. The lower part of the river is chiefly important as a navigable stream connecting the Mississippi with the canal and Lake Michigan. Steamboats regularly pass from St. Louis to Peoria and Peru, and the towns on the river furnish a good market for grain, which is sent to Peoria and Chicago. The Spoon River, from the west, and the Sangamon, from the east, are the chief branches of the lower Illinois, draining rich prairie lands which are among the best-settled portions of the state. Springfield, near the Sangamon, is noted as the home of Lincoln, as the capital of the state, and as a beautiful city.

The lower valley of the Illinois River is pretty heavily timbered. For thirty miles before joining the Mississippi it flows parallel to that stream, separated only by a narrow ridge a few miles across. About fourteen miles above Alton it joins the great current of the Mississippi, here about a mile wide, and rolls on a few miles farther to mingle with the yellow waters of the Missouri.

The Illinois River is an important connecting link between the waters of Lake Michigan and the Mississippi River. The canal makes this connection complete, and the low, narrow watershed between Lake Michigan and the Des Plaines renders this artificial waterway easy. When a ship-canal is finished between Chicago and the Mississippi, large vessels may be able to sail up the St. Lawrence and down the Mississippi, making Chicago a harbor that can be approached from the sea on either side. In winter time the river and canal are frozen up and navigation is stopped for some four or five months.

The Illinois is useful not only for drainage, to remove surplus waters, for water-power in mills and factories, for commerce, and as a means of connection between larger waters, but also for fishing which is carried on to quite an extent near the river towns.

The great irregular valley of the Mississippi is a still wider trough toward which the Illinois and other streams send their winding waters. A closer study of the rivers of Illinois will show that they all move in the same general direction. The Rock, the Illinois, the Kaskaskia, the Big Muddy, and the Wabash, all move in the same general course and all mingle their waters finally as they pass Cairo. Each of the smaller rivers has its secondary slopes, but the general slope of the whole state, with slight exception at Chicago, is toward the southwest. (It is certainly advisable at this point to make a sand map of Illinois, laying out the valleys, slopes, cities, canals, etc. If there is loose soil in the playground, it may be made on a large scale and to good advantage in the open air. It is well also for the children to draw upon the blackboard quickly an outline map of Illinois, aiming chiefly at correct proportion in the parts.)

If we now turn to a large physical wall map of the United States, it will supply a useful lesson at map interpretation to examine the neighboring states, such as Wisconsin, Iowa, Missouri, Indiana, and Minnesota, to hunt up the principal rivers, determine their slopes, compare them in size with the Illinois River, and fix their names, together with those of the states through which they flow. Such an examination will reveal several states that have a river of the same name, dividing it into nearly equal portions, as Illinois, Wisconsin, Missouri, and Min-

nesota. Then the Wabash in Indiana, the Des Moines in Iowa, the Kentucky, Tennessee, and Arkansas, bear a relation to their respective states similar to that in Illinois. This examination and comparison of rivers will lead to a perception of the chief slopes of the Mississippi Valley on a large scale. In fact, we can afford to carry this comparison a little further. The Illinois and Michigan Canal, connecting Lake Michigan with the Illinois River, is similar to a canal at the portage of the Wisconsin and Fox. In Indiana, the Wabash and Maumee; in Ohio, the Miami, Scioto, and Muskingum, are all connected with Lake Erie by canal. These are the artificial water connections between the Mississippi and the St. Lawrence system. Like the Illinois, the lower waters of streams such as the Wisconsin, Des Moines, and Scioto, are navigable, while their upper valleys are the favored courses of canals and useful for water-power and manufacturing. The fulness and detail with which the upper and lower Illinois have been described is justified

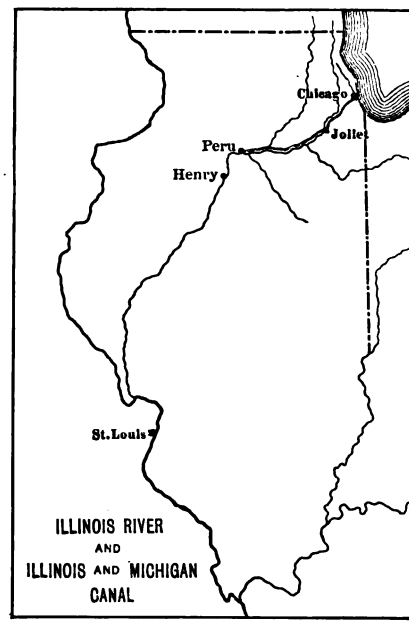


FIG. 35.

because the canal with its locks, the dams and water-wheels, the cities, bridges, and steamboats, the bluffs, bayous, and bottom-lands of the one interpret those of all the others. In several ways the Illinois River becomes a standard of comparison by which we measure other streams, and more quickly understand their size and importance. In our later study of rivers in other parts of the United States and of the world, we shall have frequent occasion to revert to the home stream as a representative and standard to illustrate slack-water navigation, bluff scenery, water-power, steamboat traffic and drainage, slope, and the erosive power of waters. In comparing the rivers of the surrounding states with the Illinois, we definitely locate these states and the rivers that drain them, fixing the names by such drill exercises as may be necessary. The power to interpret the surface features as indicated by a map should certainly be gained in this exercise.

THE PRAIRIES

ILLINOIS has been called the "prairie" state, although other states, like Iowa, are perhaps still better deserving of the name. When the white men first explored this state they followed the rivers in canoes, and as the bluffs, bottom-lands, and ravines near the streams were covered largely with forests, it seemed to them much like a wooded country. But when they climbed the bluffs to hunt the herds of deer and buffalo, they saw great stretches of beautiful rolling or level lands, treeless for miles, and covered in summer with a rich wild grass and bright with thousands of wild flowers. These waving prairies were the favorite hunting-grounds of the Indians and were grazed upon by herds of buffalo and deer. The prairies were dotted over with ponds, which, in their season, were covered with wild geese and ducks. The prairie-chicken, wild turkey, and other smaller game were also abundant. In the strips of timber, bear, wildcat, and squirrel were hunted. The Indians depended for food largely upon their regular hunting seasons and the early white explorers and settlers supplied themselves in the same way. Many old settlers are still living in Illinois who have seen the deer quite abundant on the prairies of our state.

This prairie region, though beautiful and attractive as a hunting-ground, was not deemed of much value by the early settlers. The prairie often extended for ten or twenty miles between the strips of timber.

The prairie which lies north and east of Bloomington,

Illinois, is a good type of these treeless plains. Bloomington was built on the edge of a strip of timber along Sugar Creek. To the north the rolling prairie extended nine or ten miles to Hudson, where another strip of woods is met. A line of woods about six miles west of Bloomington forms the western limit of this prairie. Near Towanda, about nine miles northeast of Bloomington, the woods again limit the prairies on that side. The main body of this prairie, then, is about nine miles by twelve and is a rolling country of great beauty and richness. In the summer time the wild grass grew to the height of a foot or a foot and a half, and, before the prairies were broken by the plough, was often mowed and the hay preserved. In the fall when the grass was dry and some hunting party had set fire to it, the flames would sweep across the prairies with a great roar and cloud of smoke, which proved fatal to animals and men in their track.

The early settlers of Illinois built their log houses near the streams in the strips of timber that bordered them. The wooded parts of the state are along the valleys of the rivers and smaller streams. Oak, hickory, walnut, maple, and other hard-wood trees form quite extensive forests along the rough or hilly country that lies close to the river valleys. These woods furnished the early settlers with materials for building houses, fences, barns, and for wagons and other farm tools. The woods also supplied an abundance of cheap fuel, while game was hunted among the groves. In fact, for many years in the early settlement of Illinois the forest districts were much more valuable and useful than the prairies.

In those early days of our grandfathers there were few wagon roads, to say nothing of railroads. Many of the

early settlers from the east came by water, some by way of Lakes Erie, Huron, and Michigan to Chicago, and some by way of the Ohio, Mississippi, and Illinois rivers. They loaded their household goods on flatboats or steamboats at Pittsburg, passed slowly down that river to its mouth, and then up the Mississippi and Illinois to Peoria, or some other river town, from which they secured teams to carry their goods across the country to the place of settlement.

The first white men paid little attention to the prairies. These broad, waving meadows, extending often for many miles, were not much used, except for hunting and pasture. But the prairie lands bordering the timber were often turned into fields for corn, potatoes, etc. One reason why the prairies were not used at first was the fact that not much grain was raised for shipment. There were no roads or good markets for grain, and the farmers only raised what they needed for family use or for feeding their stock.

But the soil of the prairies was much deeper and richer than that in the wooded regions, and the farmers learned in time that it was profitable to break up the prairies with the plough and raise grain, instead of cutting down trees, grubbing out stumps, and clearing the land for fields among the forests.

The farmers, however, who began to settle upon the prairies had a hard struggle to convert them into good farms. The soil of the prairie had never been turned by the plough. It was matted with roots, and tough and hard to break or turn. Two or three yokes of oxen hitched to a single plough were necessary to break up this old sod before the first effort at planting and cultivating could be made. The first season not much was raised, as the sod and

matted roots must rot before a good soil was formed. But with the second year's ploughing the soil was rich and mellow, and yielded abundant crops. It was necessary, also, to build houses, barns, fences, find springs or wells, plant orchards and small fruit, secure stock and simple farm tools and machines. For many years the timber used was cut and brought from the neighboring woods, or it had to be hauled from the mills, across the prairies.

In those early days the *prairie fires* were a cause of danger to the farmers. Most of the prairie, of course, was unsettled, and when fires once started across them in autumn, feeding on the thick, dry grass, with a brisk wind, the farmer on the prairie was in danger of losing houses, stacks, and stables — in fact, everything which he had worked so long and hard to secure. Various devices were used by the farmers to prevent such losses. In the fall, when the grain had been stacked, he would burn away the grass around the stacks and farm-yards, so that the autumn fires could not come near the stables, stacks, and houses, or he would plough up a circle of ground about the stacks and stables for the same purpose. Sometimes, when the prairie fires came unexpectedly upon farmers who were unprepared, there were exciting efforts to beat out the fire and save the houses and grain.

Nearly every farmer who settled upon the prairies desired to surround his farm-house with groves and orchards. Groves of cottonwood, maple, walnut, willow and orchards of apple, cherry, and plum were planted. Gardens, with small fruit, were started, large fields and pastures fenced, regular roads were laid out, and bridges built; in fact, so many changes were made in the whole appearance of the country that the Indians would scarcely

recognize their old hunting-grounds if they could return to them. Standing upon some high point or knoll on the prairies, where the eye can travel many miles in any direction, instead of a waving sea of grass, one now sees great rustling fields of corn, green meadows, yellow fields of oats and wheat as they ripen in the summer tide, the whole country dotted with groves and orchards, almost hiding the farm-houses and barns, and tall windmills towering above the tree-tops busily pumping water for the cattle or grinding grain. In a distant village are seen the church spires, the tall grain elevators, and a railroad train, moving across the country, is carrying the produce of the prairies to distant regions.

The demand for trees for transplanting in groves and orchards upon the prairies has been so great that large *nurseries* are found in many parts of the state, where thousands of seedlings are raised, and fruit trees grafted and grown for shipping and for transplanting. Evergreens, maples, fruit trees, grape-vines, berry plants, rose bushes, hedge plants, and many other ornamental and useful trees and plants have been abundantly supplied to the farms and gardens of the prairie regions. The nursery business is still a very important and extensive occupation in Illinois and other prairie states.

Many explanations have been attempted touching the cause of the treeless condition of these extensive plains in Illinois and in the neighboring states. One reason assigned is that the rainfall is less in the prairie belt than in the forest country farther east. Then the prairie fires which were accustomed to sweep the dry, grassy plains destroyed largely the young tree plants. A third reason offered is that the black, close soil of the prairies is not

favorable in a natural state to the sprouting of young trees, but in the hilly slopes near the streams where a clay and sandy soil prevails forests are common. It is supposed by some that the prairies were originally wholly covered with shallow ponds and lakes, and as the water gradually drained off through the sloughs, the marshy edges of these ponds and lakes were unfavorable to the growth of trees. Whatever the causes may have been, extensive plains in this region remained with no vegetable covering but rich grasses and wild flowers.

The soil of the prairies is, in most places, a rich, black mould from one to two feet in depth, and produced by the decay of vegetable growth. Sometimes it is possible to plough for miles without touching sand or gravel. In spite of heavy crops the soil keeps its strength and by deeper subsoil ploughing, and by proper rotation of crops, it continues to yield abundantly. The rainfalls are also so regular that a total failure of crops has not been known in the sixty years of settlement, although some seasons are too dry and others too wet for good agriculture. It would be difficult, however, to find a country with a richer soil, or a more regular succession of good harvests.

Many low places among the plains were once covered with ponds, sloughs, and extensive marshes, sometimes extending over thousands of acres where only a coarse, rank slough grass grew. These wet places could not be tilled and were of but little use. But as the prairie lands were settled up and converted into farms, the ponds were drained by open ditches or tiles which were used to draw off the sluggish waters. Some of these marshy lands cover whole townships, while the ponds and lower places on nearly every farm are benefited by tile drains. By means

of this system of artificial drainage, the swamp-land has been brought under cultivation, and these are found to be the richest and most productive districts of the state.

The business of ditching and draining the prairies has been, therefore, an important part of the growth of the state. Ditching machines have been extensively used. The manufacture of tile for drainage has been carried on upon a large scale. The big round kilns used for burning the clay, and the great stacks of red and dark tiles of different sizes, are frequently seen in the towns of the prairie region along the railroad lines.

One serious difficulty, common to all the prairie regions of Illinois, is the "bottomless roads" during a good share of the winter and spring seasons. The rich, sticky soil of the prairies holds moisture only too well, and during two or three months of the year the highways are almost impassable with loads. Ditching the roads along the sides and throwing up the dirt in the centre does not remove this difficulty, and there is so little gravel or other material suitable for road building that, as yet, no great improvement has been made.

After 1850, railroads began to be built across the prairies, bringing pine lumber and other materials to the farmers from Chicago and the lake regions, and making it possible to ship corn, wheat, cattle, and hogs to Chicago and other cities. Coal-mines were also opened, and coal was much used upon the prairies instead of wood. Before the days of railroads, it was very difficult for the prairie farmers to get their grain and live stock to market. They sometimes hauled wheat and salted meat a hundred miles to market in wagons. Since 1850, therefore, the settlement of the prairies has been very rapid. Even as

late as 1870, however, there were many prairies in Illinois that were unfenced and still covered with wild grass, upon which any one could freely drive his herds. But since then most of the prairie districts have been fenced and ploughed, and are now yielding large crops of grain or serving as pasturage.

The description we have given of the prairies of Illinois will answer, also, for most of the prairie states. Northern Missouri, the whole of Iowa, and southern Minnesota are very much like the prairie lands of Illinois. The eastern half of Dakota, Nebraska, and Kansas, also, belong to the prairie belt, and are corn, grain, and stock producing regions like Illinois. The northern part of Indiana and the southern part of Wisconsin show extensive prairies. There is no fixed line between these prairies and the arid plains of the west in Dakota, Kansas, and Nebraska. The one hundredth meridian may be taken as the line that separates the region of sufficient rainfall on the east from the arid plains on the west. West of the Mississippi, therefore, the prairies have a gentle slope upward till they are gradually changed into the grazing and ranch lands of western Kansas and Nebraska, where there is not enough rainfall with which to raise crops.

Before leaving the prairie region it is advisable to locate the chief rivers which drain the prairie belt, the direction of their slopes, the states and parts of states included, and perhaps a few of the chief cities or trade centres which lie within this district. It will be of interest, also, to notice how far the coal area, studied in the preceding topic, lies within the prairie belt, and to what extent the use of coal on the prairies is rendered easy.

The definite location of the prairie states on a wall map, and the drawing of the states in outline will aid the fixing of these facts.

We shall find later, in discussing corn and live stock, lumbering, pine- and hard-wood forests, that much additional light will be thrown upon the prairie country, and the comparison of it with the forested regions will help to give a much more definite knowledge of the surface, commerce, and productions of those parts of our country.

THE PINERIES AND LUMBERING

In northern Wisconsin and Minnesota, where the forests of white pine abound, the short, cold days of winter are the busiest season of the year. The ground is usually covered with deep snow which contrasts with the dark green of the forests. But the branches are often loaded with snow and ice so that Jack Frost is monarch of all. In the autumn, every large lumber firm which has pine lands in this region prepares to make up a company of lumbermen to send into the forests to cut down and prepare the logs for the springtime. The foreman of the lumber company scours the river towns, hiring men for the winter campaign. As soon as they have spent all their earnings in the boarding-houses and hotels, the men are ready to pack up for the logging camp. Sixty men make up a logging camp of average size. Such a camp is located in the midst of the woods, near the bank of some stream, which, when the melting snows and rains of spring come, can float down to the far-away mills the great piles of logs which the men have collected upon its banks during the winter season.

We will describe such a lumber camp on a branch of the Upper Mississippi above Minneapolis. (See *Scribner's Magazine*, 1893.)

The camp consists of several buildings "made of round logs and roofed and floored, generally, with rough boards. There is a men's camp, where the men lounge and sleep;

a cook-camp, which is a large dining room and kitchen combined, and a large barn where the hay is stored for the

FIG. 36.

A group of small pictures to illustrate lumbering. A and B show logging camps; in D logs are being drawn to the frozen stream; E and F are pictures of two log jams; and C shows a vessel loading lumber from the piles of boards on the wharf near the sawmill.

horses and mules; a granary, a blacksmith's shop, and an office for the foreman, with an extra bed for the proprietor.

The men's camp for sixty men and the cook's camp are each about sixty by twenty feet. The men sleep in rough wooden bunks, ranged in double tiers along the sides of the camp. Formerly they lay on boughs or on hay with a single blanket spread over it, but in these days they have their bedticks stuffed with hay or straw." A big fireplace used to add cheerfulness to the great barnlike room, but now large stoves are used.

There is much work to be done about the camp, in the woods, and along the river, before the actual work of felling the trees and hauling the logs begins. A gang of men is sent along the river for many miles to clear it of snags. It is a heavy piece of work, wading into the icy waters, loosening the stumps and logs and dragging them out with horses. The men camp on the banks at night and wade the streams and labor during the day for weeks at a time. But at last the river is clear for the spring freshet. Early in the fall, road-makers are sent out to the lumber camp to lay out and prepare smooth, well-graded roads along which the heavy sledges, with horses, may safely haul the great loads of logs to the banking grounds along the river. The making of these roads is a very careful piece of business. "Along the lines which have been carefully laid out, the road-makers fell the timber, cutting it at the roots so that no stumps remain, log out the road at its proper width, and then, with plough and scraper, mattock and shovel, make it nearly as level and quite as solid as a railroad grade. The road-bed is sunk a little below the level. It is ploughed out after each snow-storm with great snow-ploughs, and sprinklers are run during freezing weather, making a solid bed of ice over which enormous loads can be hauled." The log sleighs are from

ten to fourteen feet wide on the cross-beams, and one or two teams are hitched to them. Of course, before beginning the winter's work, a large supply of food and materials must be hauled to the camp. Hay and grain for the horses, tools, sleds, blacksmith's materials, besides food, clothing, and medicines for the men are provided.

When finally the winter's work begins in earnest, a logging camp is a busy place. Squads of men are sent out to fell the trees; the teamsters are up early to feed and groom their horses, so as to haul as many huge loads as possible to the river bank; the cook and his helpers are busy almost day and night, preparing and cooking food for the hungry men. The blacksmith is shoeing horses and repairing sleighs and tools. The foreman keeps track of all the men, their time and amount of work, and must see that every man earns his wages.

The men are out early at the trees, working in pairs or groups, and engaged in a generous rivalry to see who can bring down the most trees and logs. The trees are now generally sawed down instead of cut with the axe. By driving a wedge into the saw-cut, a tree can be thrown into any desired direction. When the tree is down, it is divided off into standard lengths and sawed up. Then the logs are ready to be taken to the skids. "The skid-way consists of two logs about ten feet apart, laid perpendicular to the log road and well blocked up, upon which a tier of logs is placed ready to be loaded on the sleighs to go to the banking ground." To get the logs to the skid-way, cattle were once much used, but now horses. Sometimes the logs are "snaked" along, being held at the end by a grappling hook called "skidding tongs"; but the big logs are dragged by a team, with a rude sled for one end of the

log to rest upon. From the skids, where the logs have been piled up by the loaders into lofty tiers, they are rolled on to the sleighs. "When it comes to loading these logs on the sleighs, judgment and strength and skill are equally required, the object being to get as large a load as possible." The logs have to be well balanced and firmly laid, or they slip and slide back. Sometimes the load is piled up as high as a load of hay, and contains many tons of logs. The teamsters then drive carefully along the smooth road. They pass men whose business it is to watch the road, fill up low places, smooth the track, and thus prevent the sleighs from sliding out or toppling over. At the banking grounds, again, great skill and strength are needed in piling the logs on the edge of the stream, where they may easily roll into the water in the spring.

Deep and lasting snows are of great importance to the lumbermen. In some winters, when there is little snow but much rain and slush, the skids are full of logs, but the sleighs cannot run. Many thousands of dollars' worth of logs may be piled up, but cannot be brought to the stream. If the weather is cold, the sprinklers are set at work and an ice road is made, over which the loads will glide. In many cases railroads have been built into the logging regions and the logs hauled out by steam power to the banking grounds. The snow, then, is of great value to the lumbermen both for skidding and hauling the logs and for melting in springtime so as to flood the stream and carry off the logs.

In the evening, after the hard day's work, the camp is a lively scene. The hard-worked men have a hearty relish for substantial food, and they get it in abundance. "At dinner there is a hearty bean or vegetable soup, and gener-

ally fresh beef. For every meal there are pork and beans, corned beef, potatoes, turnips, cabbage, and sauer-kraut, plenty of sugar, tea, coffee, molasses, gingerbread, dried apple pie, mince pies from mince-meat bought by the half ton, sauce, and butter. With sixty men, a barrel of flour must be converted into bread in about two days. After supper there is rest and entertainment. Along each side of the camp is a seat made of a thick, hewn slab, for which the bunk frames furnish a back. When evening comes,

FIG. 37.

Floating lumber on a stream in Wisconsin.

ranged along this seat, or lounging in the bunks, the crew of men become a social club. Then jokes and tales go round and songs are sung, and if there is a fiddler in the camp dancing begins." But the men must soon get to bed so as to be up betimes for the morning's work.

There are many dangers and accidents, and the reckless boldness of the men in handling logs leads to broken limbs and mangled bodies. In piling the logs on the skids and at the banking grounds there is special skill and strength needed to prevent serious accidents, but the men are generous in helping an injured comrade.

With the melting of the snow and ice in spring comes

the breaking in and driving the logs. The banking ground swarms with men armed with cant-hooks, furnished with strong pikes in the end, who attack the great tiers of logs as they lay piled on the landing. Teams hitched to lines, at the end of which is a hook similar to a cant-hook, are used to loosen the "key log." This hook is driven firmly into a log at the foot of the rollway, and as it is pulled out the whole face of the rollway topples forward into the stream. This must be repeated again and again. Sometimes while men and horses are tugging to loose the log it suddenly gives way, and down thunders the towering mass of logs. The men jump for safety to the sides, they clamber and keep atop of the plunging logs, they jump for safety into the surging stream, coming out generally unhurt.

As soon as the logs are set afloat, two crews of men are sent out to drive the logs down the stream to the boom, where they are collected and sorted. The forward crew is called the "jam crew," whose business it is to string the logs along the river so as not to let them pile up together and get wedged in the stream. Sometimes the body of logs lodges in a narrow passage or bend of the river, or upon some snag or sunken tree-top, and the logs must be loosened and again set afloat. A great log jam, however, is sometimes formed which extends for miles up the river. The force of the current piles up the logs in great heaps, with tree trunks projecting in every direction. To break such a jam and send the loosened logs floating down the stream is difficult and dangerous. A rear crew follows to gather up the stray logs that have become stranded along the banks and bayous when the water was high. With cant-hooks the crew of men roll the logs into the stream. Many logs are thus left high and dry on sand-

bars and in the bayous by sudden floods and changes in the water. These must all be rolled down to the stream and set afloat. The heavy butt logs drag in the low water and must be helped over shallow places. The men wade into the chill waters, ride the logs over the rapids, and are wet from head to foot most of the time. But they get double wages for this arduous work and exposure.

At length the logs from different companies are collected, many acres of them floating along the bayous and

FIG. 38.

A sawmill in Wisconsin.

river banks, above the boom. The logs of each company are marked with certain letters, and so squads of men from the different companies are set to work to collect the logs of each company by themselves and form large rafts, which are then sent down the river with rafting steamers to the sawmills. Sometimes three or four hundred men are employed at a boom collecting and arranging the logs for many different companies.

The sawmills lower down the stream are kept very busy

in summer and fall, sawing up the logs and stacking the lumber. Many of the lumbermen work in the mills in the summer and in the logging camps in the winter. The machinery of the mills at Minneapolis was formerly run by the water-power of the falls, but now most of the large sawmills are above the falls and are supplied with steam-engines. The sawdust from the mills is the only fuel used and much more is produced than is needed in the furnaces. The mill stands on the river bank and a great raft of logs lies floating in the water below, from which they are drawn up singly into the mill by means of an endless chain with hooks. A hundred men may be employed in a single mill and the circular and band saws, and especially the gang saws, turn out great batches of lumber in rapid succession.

Above the falls at Minneapolis are many of these large mills with extensive lumber-yards, where vast quantities of lumber are stacked, while in the waters of the river are great rafts of logs waiting for the saws. In the same yard with the sawmill is often found a planing-mill, where the rough lumber is planed and worked up into window-frames, casings, doors, and other finishing lumber.

Most of the logs of the Upper Mississippi are worked up in the sawmills at Minneapolis. Quite a number of the stray logs go over the falls and are received by mills in the cities lower down the river. Minneapolis is therefore a very important centre for the manufacture and shipment of pine lumber. The great prairies of western Minnesota and Dakota call for immense quantities of pine lumber for use in house building, for barns, bridges, fencing, and many other things. The railroads reaching westward from Minneapolis are largely engaged in hauling this lumber to the western towns. The mills at Minneapolis

are constantly taking orders from these western cities, and the success of their business depends upon the amount of lumber needed on the farms and in the towns of the prairie regions. A failure of crops in Dakota is therefore a serious drawback to the lumber merchants of Minneapolis.

It is clear, then, that the pine forests of northern Minnesota are quite important to the farmers of the prairie regions. But the winter snows in the pineries, the spring floods in the rivers, the sawmills at Minneapolis, and the long railroad lines stretching westward, are necessary to bring the prairies and pineries into close and cheap communication. The lumbermen in their camps must also receive their flour, corn, and grain, besides beef and other meats, from the farmers of the prairie districts. Thus the exchanges take place.

Having seen the movement of logs from the lumber camps along the Upper Mississippi to Minneapolis, and the distribution of lumber from that point westward, we may expand this idea to observe how far it is repeated in other states. There are several large lumber streams that flow into the Mississippi below St. Paul, as the St. Croix, Chippewa, Black, and Wisconsin. They send thousands of logs into the Mississippi, which are sawed up at the great sawmills at Wabasha, Red Wing, Winona, La Crosse, Davenport, etc. In fact nearly all the towns, large and small, along the Mississippi from St. Paul to St. Louis, are lumber towns with saw and planing mills, and railroads stretching westward over which the lumber is shipped into Iowa, Kansas, Nebraska, etc. The leading industry in nearly all these towns is lumbering and milling. Again, if we look toward eastern Wisconsin and northern

Michigan, both in the upper and lower peninsula, we shall find numerous logging rivers, lined with lumber camps and sawmills. Thus it is that such immense quantities of lumber reach Milwaukee, Chicago, and other lake ports to be shipped west and southwest into the prairie region. Chicago is one of the greatest lumber markets in the

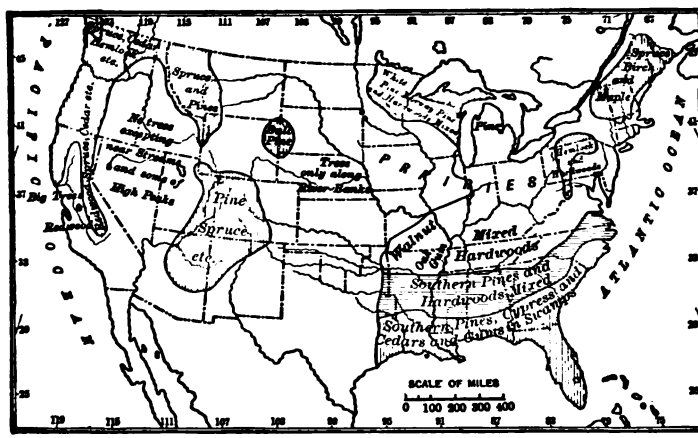


FIG. 39.

Map showing the regions from which considerable timber is now being obtained.

world because of the ship loads of lumber that come down to Lake Michigan and to other lakes from the lumber streams in the pineries. Bay City, Detroit, and other cities of the lower peninsula are important centres for the lumber business. If we care to extend this inquiry we shall find that that part of Canada which borders the Lakes, the St. Lawrence, and its tributaries, is all a region of pineries and lumbering similar to that in Minnesota. Later, in our study of the Eastern States, we shall be interested to see

that northern New York, along Lake Champlain and the Hudson, and the rivers of Maine, are the centres of a lumber business almost identical with that of the upper Mississippi.

After such an inquiry as is just suggested, we are prepared to fix the region of pine forests in, at least, Minnesota, Wisconsin, and Michigan. In doing so we have an opportunity of locating those states more carefully, also the chief tributaries of the upper Mississippi and of the lake region, and those cities which are important centres of the lumber trade and their facilities for this traffic.

It may be well at this point to compare more carefully the prairie regions already treated with the pine forests in regard to soil, climate, and general appearance of the country. The contrast is a striking one. These tall, gloomy pineries, rooted in a light, sandy soil, which is good for little else, contrast strongly with the black mould of the prairies which in its natural state supports only grasses and wild flowers. And yet these two regions are very necessary to each other. The study of the mines in the lake regions will make this still more apparent.

THE UPPER MISSISSIPPI

THE great river above its junction with the Missouri is very different from the stream below. Above St. Louis the river is lined with bluffs on both sides. It is a mighty trough, crooked and irregular, winding and twisting its way southward between high bluffs, which give great variety of scenery, and, being crowned with waving forests or steep with bare rocks, furnish splendid panoramic views as we pass up or down the river in a steamer. Many of the cities like Quincy, Davenport, Clinton, and Dubuque have a commanding position on the slopes and bluffs skirting the wide valley. Just above Davenport and Rock Island the river passes the rapids and rocky ledges which have made navigation at this point difficult and dangerous. Here also is the island which the government has made into a great park with arsenals and a military station. Between the island and the west shore the government has built a series of jetties and rocky buttresses in the channel to narrow and deepen the current. But during low water in July and August the steamers and barges have difficulty in passing these rapids. Here, as elsewhere, the river has broad bottom-lands, often well wooded and furnishing a rich soil for corn and grain when not flooded. As we move northward the bluffs gradually grow higher and more commanding, and the streams coming down from the prairies on either side must cut deeper channels in order to reach the river. There is a great profusion of forests along the

FIG. 40.
View on the Upper Mississippi.

bluffs, which give an appearance of luxuriance to the valley which is in keeping with the richness of the country.

Between La Crosse and Winona the river valley reaches its grandest proportions, and its isolated bluffs appear almost as mountains.

Before leaving Winona, however, it is well to take a glance at the panoramic view there furnished. Standing on the bridge across the lake, which is really an old channel of the river, or at some other point where there is an unobstructed view, how far can the eye travel across the valley and along the bluffs on either side? Perhaps we shall not find a broader or more interesting sight than is spread out at our feet. As we go up the river we shall take notice if anything finer than this appears. At Winona the bluffs on the south and west sweep round in a great curve like an immense bow, and if a string were stretched from Trempealeau Mountain in the southeast to the corresponding hills in the northwest, Winona would lie inside, *i.e.* between the bow and the string. The bluffs to the southeast look like distant mountains, while the receding ridges to the north appear almost like successive steps as they fade away into indistinct outlines in the distance. Standing on the brow of the bluff more than five hundred feet above Winona, we may look up the great river valley about thirty miles, and southward through the narrow gorge at Trempealeau to La Crosse, an equal distance. On the other side lies Wisconsin with its castled rocks and wooded ravines.

Without dwelling longer upon this, we embark, and soon find that the river has a devious course among the lowlands. The bluffs are by no means straight in their outlines, but the channel of the river is much more crooked.

Why does the river make such a winding course among the sand-banks, jogging from one side of the broad valley to the other? Just above Winona we know there is a network of bayous. How have they been formed? In times of spring floods the whole broad valley, from four to seven miles from bluff to bluff, is nearly covered with the rushing waters; old channels are cut off and partly filled, while new ones are opened. Even when the water is not so high the current is constantly changing the channel, drifting in sand in one place and washing it away somewhere else. Jetties are built near Winona to deepen the current. They appear as narrow ridges of stone run out into the stream at intervals to confine the current in a narrow channel. We begin now to see what difficulties the pilot on our boat has to meet. Not only must he know all the windings of the current by day and night, even in the dark, so as not to run aground, but he must keep track of the changes which take place by the drifting of the sands.

We are already familiar with the ravines that lie between the bluffs. On our left we soon see the still broader opening where the Rollingstone comes down to join the Mississippi. Here lies Minnesota City, one of the oldest settlements in the state. Just before reaching Wabasha, the opening in the bluffs on the west shows where the Zumbro River comes in, upon a branch of which Rochester is situated. Just beyond Wabasha the Chippewa, the great lumber stream of Wisconsin, joins the Mississippi from the north. The town itself, like Winona, is a county seat. There is also a bridge of boats across the river with a draw, through which our steamboat passes. It is a town much like Winona, only not so large. Sawmills and great piles of lumber, machine shops and factories, can

be seen. Being just below the mouth of the Chippewa, Wabasha can get lumber rafts from Wisconsin as easily as Winona and other cities below. Beyond Wabasha the Mississippi bends more toward the west, and not many miles up the river we enter Lake Pepin.

The bluffs are nearly as high along the lake as at Winona, but only about half as far apart. Nearly the whole valley, however, between the bluffs, is filled with a deep lake, twenty-five miles long and from two to three miles wide. On the west, one long bluff, near Lake City, is entirely covered with forests. On the other side, in Wisconsin, stands Maiden Rock, from the top of which, according to Indian story, an Indian maiden jumped, because she was not allowed to wed the man she loved. Her name was Winona. Standing on one of the cliffs by Lake Pepin, one gets the finest view along the Mississippi in Minnesota. The bluffs themselves, rocky or covered with forests, are as striking as those near Winona, but between them lies the deep, dark lake, filling the whole valley. Several towns and villages are in sight along the margin of the lake, steamboats and rafts move along over the water, while swift, rumbling railroad trains may be seen, at times, going up or down the valley on both sides of the lake at the foot of the bluffs. This is a sight well worth studying, and to make it vivid and real, use the best pictures that can be obtained.

Between the upper end of Lake Pepin and the mouth of Cannon River is the town of Red Wing, which not only has flour and saw mills, like Winona, but also a pottery, where jars, crocks, and other stoneware are made. A kind of clay is found here which can be moulded into jars, etc., and after being dried is baked and burned in large

kilns or ovens. This reminds us of the way in which bricks are made and burned in the brick-kilns at home. Whatever additional facts of interest and pictures connected with this business the teacher can give will be of value at this point. At Red Wing there is also a boot and shoe factory, where boots and shoes are made much more rapidly than by shoemakers at their benches. How is it done? We said there were sawmills at Red Wing. Where do their rafts of logs come from? From the Chippewa? But the mouth of the Chippewa is too far down! Are lumber rafts floated down the Cannon River from the west? No. The Cannon River comes from a prairie country, or from a region where there are no pine forests. Perhaps there is a lumber river farther up the Mississippi coming from the pine forests. We shall see! Just above Red Wing, where the Cannon River comes in from the west, there is a bottom-land as broad as the valley of the Mississippi River. A railroad from Red Wing follows the valley of this river toward the west to Cannon City, Northfield, etc. The Cannon River is lined with fine bluffs and wooded hills, and is a pleasant trip for sight-seers in fine weather.

But from Red Wing we keep up the Mississippi River to Hastings. Just before reaching this city we notice a large river coming into the Mississippi from the north, the St. Croix. This is the great lumber stream for which we have been looking. It comes from the pineries and sends down great rafts of pine logs in springtime. It was at a narrow place in this stream that the big *lumber jam* recently occurred. If possible show a good picture of this and explain it. Many of the rafts for Wabasha, Winona, and other towns are first floated down the St. Croix. At

Hastings is another great railroad bridge across the Mississippi which swings open at the sound of the steamboat whistle. This is the bridge where the trains of the Milwaukee road from Winona cross the Mississippi before coming to St. Paul. At Hastings, a little river, the Vermilion, comes into the Mississippi from the north. As it passes over the rocks it forms the beautiful Vermilion Falls near the city. Hastings, too, has flour-mills and saw-mills. Why is it that every one of these towns along the Mississippi has large flour-mills just as Winona has? Where does all the wheat come from that is ground in these mills? Why are all the important towns between Winona and St. Paul on the Minnesota side of the river, — Winona, Wabasha, Red Wing, and Hastings? On our journey north we may have noticed that the bluffs are growing lower along the Mississippi. Before reaching St. Paul there are two other points of interest, Kaposia, the old Indian village just below the great bend, and Carver's cave in the white sandstone rocks just below St. Paul. Here the Indian tribes were accustomed to gather at the opening of every spring.

As St. Paul comes in sight there seems to be a lower and an upper town. The lower town, where the wharves and stations are, is not many feet above the level of high water. This level land reaches back from the river in a sort of broad valley. Farther up the river we can see large buildings on the edge of steep, white bluffs. Several bridges for railroads and wagons cross the river to the south. Most of them slope toward the south side, because it is lower. The steamboats can get up no farther than this, and at the wharf in St. Paul they unload their cargoes and take on such grain, flour, and produce as they

may desire to carry down the river. The river barges also unload their sand, brick, and building stone at the wharf. Where does the building stone come from? Red Wing and Dresbach. We need some good pictures of the city and river at this point. Close at hand is the great railroad depot, with its many roads and trains coming and going at all hours. On the way up the river we have noticed the railroad tracks and trains on both sides of the great valley. Which are more rapid and convenient, the trains or steamboats? Which do the greater business?

Here let us take a general survey of the surface features of the whole state. Briefly, it is as follows: At St. Paul or near there the Mississippi and its tributaries branch out like a fan and drain the great interior of the state. Beyond this the Height of Land, a low ridge of rounded hills, circles about the sources of the Mississippi from the western to the northeastern part of the state. From this ridge one may look down on the streams and lakes which send their waters southward to the Gulf, or on the other side upon streams and lakes that flow northward into Hudson Bay. With chalk in hand, sketching the outline, the teacher may point out the forest and prairie regions of Minnesota, besides the pineries already noticed, the "big woods," then the courses of the Red River and Rainy Lake River.

St. Paul is really the head of navigation, but excursion steamers go up the river four or five miles to Fort Snelling and Minnehaha Falls. Both are on the west side of the Mississippi, the fort on a steep white bluff nearly a hundred feet high at the angle where the Minnesota from the southwest joins the Mississippi. This old fort, with its white walls and rock, the old meeting place of Indians,

soldiers, and traders, is one of the most picturesque and historically interesting places in Minnesota. A high bridge crosses the river from the bluff at the back of the fort to the bluff west of St. Paul, so that the old fortress is easily supplied with needed materials and provisions. Some two miles farther up the Mississippi is the entrance to the valley and Falls of Minnehaha. It is a deep narrow cañon a mile long and filled with trees and shrubbery. At the upper end of the valley, Minnehaha Falls tumbles over the semicircular rocks into the gorge and the water winds its way through the narrow valley to join the Mississippi. Grounds have been laid out for a park along the bluffs above and a street car runs hourly to Minneapolis. For five or six miles below the falls at Minneapolis the Mississippi River flows through a narrow cañon from eighty to one hundred feet deep. Just above the falls the river bank is only twelve or fifteen feet high. The falls have been slowly receding toward the north as the waters in tumbling over the ledge have worn and crumbled the rocks, and the deep, narrow cañon below is the product of the action of the falls. But by boarding up the falls with a framework of timbers and forming great chutes down which the water glides, the action of the water upon the rocks has been checked and the scenery destroyed. Bridges cross the river both below and above the falls. Those which cross below must span the cañon and are therefore much higher above the water. Just below the falls and on the east side are the extensive grounds and buildings of the University of Minnesota. They stand upon the bluff a hundred or more feet above the level of the river. Just above the falls are the extensive lumber-yards of a half-dozen great sawmills. A

long island divides the river just above the falls and both the currents above the bridges are almost filled with acres and acres of floating logs. This is the greatest centre for the lumber trade of the northwest. In the time of spring floods the river still makes a majestic appearance at the falls as it descends with a mighty rush the forty feet to the waters of the cañon below. Even in summer time when the water is low it is interesting to stand on one of the high bridges below and watch the stray logs come tumbling over the falls. One can observe, too, that the greater part of the current does not pass over the falls at all, but emerges in a large stream from the foot of the mills after passing through the big turbine wheels that move all the machinery of the greatest flour-mills in the world.

There is much navigable water above the falls, and in springtime especially the rafting steamers are busy bringing down the log rafts to the mills. But there are several falls and rapids in the upper stream that furnish excellent water-power as yet not much used, but hindering navigation. Navigation on the upper stream is also hindered by snags and obstructions, but these must be removed in springtime so as to free the river for rafts and steamers. The upper part of the river from a line sixty miles north of St. Paul is in the region of pineries, from which the pine logs come. This is also the region of numberless lakes where hunting and fishing are still in their prime. Minnesota is said to have ten thousand lakes, and those most attractive for hunting and fishing and for solitude are on the high plateau where the Mississippi takes its rise. There the great woods are solitudes, the lakes and rivers are clear and fresh, and the fish and fowl abundant. The great river itself, in its early upward course, passes

through a number of smaller and larger lakes as it makes the great bend to the east and south. It passes over many rapids and falls as it descends from the uplands, and steadily grows as new streams from the woods and lakes enter it from either side. In winter time this is a very cold country of deep snows and snow-shoes, and a quiet but steady freezing atmosphere. But in summer it is the chosen land of the hunter and boatman.

The head waters of the Mississippi and of its tributary streams, with their lakes and forests, have become an object of great interest to the people dwelling along the banks of the river throughout its whole course, even to New Orleans and the delta. The woods, lakes, and streams of the Upper Mississippi in Minnesota and other states are the great reservoir from which the floods come down to break the levees and flood the lowlands of Mississippi and Louisiana. Of course the sources of the Ohio and Missouri are equally responsible. Now, if these floods of water in springtime can be checked and held back, in part at least, it will help to save the lower river from destructive floods. But in summer time the upper river, from Rock Island to St. Paul, is often too shallow for the regular steamers. If these waters, which have been held back in springtime, can be let go to deepen the river in the drouth of summer, it will greatly aid the navigation of the upper stream. The government, therefore, has been at work for some years constructing and arranging for great reservoirs in the upper sources of the Mississippi, by which the spring waters may be held back. Still another advantage of such reservoirs would be that it would make the season of floating logs down the river longer and also supply the great mills at Minneapolis and

elsewhere a larger water-power in the summer time when it is needed. It is apparent, therefore, that all parts of the great river stand in close dependence upon each other. The forests in the north are very important as a means of water preservation and must be protected for their great public value. In winter time the northern part of the valley is a reservoir from which to cut and ship vast quantities of ice to the south, while the other products of the north and south are exchanged by boat.

The purpose of such an excursion as this is to bring together into one connected series the idea of a river valley with all its living pictures and associated facts, — the narrow, winding valley, the panoramic views of bluffs, lake, and broad bottom-lands, forests, villages, cities, industries, tributary streams, bridges, railroads, rafts, steamboats, and river commerce. All this is to become vivid and clear, and a good type of a great river valley upon dozens of streams the world over. The more good pictures and illustrations of these and of similar scenes on the Mississippi, the more vivid descriptions based on experience and reading, the better. One complete and detailed account of a river trip like this is more productive of knowledge and insight and more helpful to future geography study than a dozen superficially studied. What is true of the Mississippi will be found in the main to be true of the Hudson, of the Rhine, and of the Danube, and it will be tenfold easier to understand one of these distant rivers and the country through which it flows if we first form a concrete and detailed picture of one of our own great streams.

Just as we have already dealt with the lumbering business in detail and with the Upper Mississippi, we

are ready now to do the same for the wheat and flour mills. We desire an exhaustive account of the work on a wheat farm, the ploughing, sowing, harvesting, threshing, granaries, and marketing of the grain; the scenes from a great wheat-field, a characteristic thing for Minnesota, the machinery used, — ploughs, drills, self-binders, threshing machines; how the wheat is brought to the stations and elevators, then carried by the chief railroad lines to Minneapolis and other river cities, to the big mills; what is done with such quantities of flour after it is made in Minneapolis and Winona and other cities; where the hungry people live who want all this flour for bread; and what they have to send us in return.

THE HARD-WOOD FOREST REGION OF THE OHIO VALLEY

CONTRAST the appearance of the Ohio Valley now and two hundred years ago.

Indiana is much of it to-day a well-wooded country. There are large forests of oak, hickory, maple, beech, poplar, walnut, sycamore, and other hard-wood trees. The southern half of Indiana still contains extensive forests, while the northern quarter has level prairies and swamps. As one rides on the railroads through Indiana, he will see large piles of sawlogs near the sawmills at the towns and cities. These are being worked up by the saw into useful lumber. If one travels out into the country, he will find in the woods sawmills, run by water or steam power. Many of the fields are still sprinkled with stumps, and in some places we see the dead trees standing which have been girdled the last season. After the trees die, they are cut down; those good for lumber or wood are cut up and hauled away, while the brush and other tree trunks are burned up. These smouldering fires are often seen by the traveller passing through the Ohio Valley. During the last eighty years the great forests that covered the hills and plains and valleys of this region have been largely cut away, and the stumps have rotted in the ground or were pulled up and burned. There are, therefore, many large, open fields and districts of country where meadows of

grass or fields of corn, wheat, oats, potatoes, and other grains or vegetables are seen. Indiana, Kentucky, etc., have thus grown to be very rich agricultural states, with many cities, towns, and railroads. When the white men first began to settle these states and make homes in the wilderness, it was totally different from what is seen to-day. The great woods, with their towering trees, covered nearly the whole land. Very old men now living can remember when the Ohio Valley was one large forest, with no railroads and very few wagon roads.

The early settlers in Indiana were the French at Vincennes and along the Wabash River. They were a joyous, happy people, who were very friendly with the Indians and were good wood rangers and trappers. They hunted deer and buffalo, wild turkey and squirrels, and other wild animals for their pelts. When they travelled, it was either on foot as hunters or in boats up and down the rivers.

At the close of the French and Indian wars, the Yankees and other English-speaking whites began to cross the Alleghany Mountains into the Ohio Valley. From Pittsburg they came down the Ohio River in flatboats and canoes and landed near the river in Ohio, Kentucky, and Indiana. The very first thing (as at Cincinnati) was to clear away the brush and trees of the forest, making room for houses and forts and gardens. As one rides in a steamboat along the Ohio River to-day, few of these old forests are seen left standing. They have been cut away from the bottom-lands and the level upper bottoms, and only along the steeper hillsides and bluffs are many trees seen. As the early immigrants landed on the north bank of the Ohio in Indiana they had to make their way through

the woods, and up the ravines to the better lands back from the river (as in Lincoln's early boyhood). There were no roads for wagons, and when a good spot was found for building, trees were felled, a clearing made, and the rough tree trunks were squared down with a broadaxe and a log house commenced. The ends were notched and the logs jointed together at the corners. The pioneer was his own carpenter. He had saw and axe, plane and auger, and other tools, and was strong and skilful in their use. The log hut often had but one room, with a loft reached by a ladder or by pins driven into the logs, and it was used by the older children as a sleeping room.

The early settlers lived partly by hunting and partly by raising crops on the clearings. Before crops could be raised the trees had to be cut down and burned up, a very heavy labor, and when the stumpy field was ready it was ploughed and put in corn or wheat, melons or vegetables.

At first there were no public surveys, and the settler selected a spot to suit himself. "Deadening a patch of woods near the head of a spring, cutting the initials of the claimant's name on the corner trees, and throwing up any sort of a hut constituted an improvement. Division lines were chiefly on the water courses, or on the top of the ridges. The earliest farms, therefore, resembled an amphitheatre. The cabin was always on the lower ground, which pleased the squatter because of its convenience; everything came to the house down hill." — American Commonwealths, "Ohio," p. 191. Afterwards, when the land was laid out by public surveys, these old farm-houses were found to be far from the roads. Later people began also to build on the higher lands, but for many years the old settlers believed there was less ague in the lowlands.

"The millions who are dwelling in peace and plenty in the broad farms and busy towns of Ohio and Indiana to-day can get no realizing sense from mere words of the hardships by which their prosperity was earned. The toilsome journey of the pioneers, the steep mountain ways, the camping out, where there were no inns and hardly a road to guide them, were as nothing to the dreariness which, at the journey's end, confronted the immigrant and his devoted wife and tender children. The unbroken forest was all that welcomed them, and the awful stillness of the night had no refrain but the howl of the wolf or wailing of the whippoorwill. The nearest neighbor often was miles away.

"Their first necessity was to girdle the trees and grub a few acres for corn and truck patch, sufficient for the season. As soon as the logs were cut a cabin was built with the aid of neighbors. Necessity invented the house raising, as it did the log rolling and corn shucking." When the logs and timbers for the framework of the house were ready the neighbors were called in, and the heavy structure was lifted into place by the united strength of the men. When the work was done a feast and jollification followed. Neighbors were accustomed to help each other often in such ways, and to join in the corn huskings, bear hunts, log rollings, and weddings, the latter lasting usually three days.

"The log house, with its clapboard roof, single room, and door, if any, swinging upon wooden hinges, with no window but a patch of greased newspaper between the logs, and no floor but the ground, was often finished at nightfall on the spot where the trees had stood in the morning. The daubing of the chinks and wooden chimney

with clay and a few pegs in the interior for the housewife's use were all that this simple cabin in those days could afford.

"But food rather than shelter was the severest want of the pioneers. True, the woods were full of game, but venison, turkey, and bear meat all the time became tiresome enough. There was no bread nor salt. The scanty salt springs (salt licks) were precious. The Indian corn, when once started, was the chief reliance for man and beast. This crop, converted also into bacon, pork, and whiskey, soon became the staple of the country. The lack of mills was at first deeply felt. Corn was parched and ground by hand or by horse power.

"The furniture of the cabins and dress of the people were very simple. Good tables, cupboards, and benches were made of poplar and beech woods. The buckeye furnished bowls and platters and split-bottom chairs. Bearskins were bed and bedding. The deerskin, dressed and undressed, was much used for clothing, and the skins of the raccoon and rabbit were a favorite headgear. But wool and flax soon abounded and spinning-wheels and looms became standard articles in every house. The hulls of walnuts and butternuts were used for dyeing, also a root of bright yellow, and later indigo and madder for the hunting shirt and warmus. These primitive fashions yielded as store goods, together with iron and Onondaga salt, began to be introduced by the great Pennsylvania wagons from Pittsburg and the ports along the Ohio. Goods were also brought up the river from New Orleans in keel boats.

"The pioneers had pastimes and festivities also in their own way. Besides others, there were the sugar camp, the militia musters, the bear hunts, the shooting matches, and

the races. At these the neighborhood for miles around was wont to gather. The quilting party was a joy in feminine circles. The camp-meetings were another early custom, and used to supply the place of Sunday worship."

Travelling was at first mainly on foot and on horseback. There were few wagon roads, and those very rough and in many places miry and bad even in good weather. The great forests kept the soil so moist that the roads could not dry out. It was very difficult for some years to get the surplus grain and meat to market. In the spring, at the time of floods, flatboats would be loaded with meat or grain and sent down the smaller streams to the Ohio, and thence to New Orleans. When a few roads had been built, the farmers would haul their meat and grain many miles to Cincinnati or other river towns, and purchase goods with the money gained from their produce.

The early settlers in Indiana, Ohio, and Illinois needed a better connection with the eastern states from which they came. As early as 1808 they secured aid from Congress in building a road from the tide-water east of the Alleghanies to the Ohio River. This old national road crossed the Ohio River at Wheeling and ran across Ohio, Indiana, and Illinois, passing through Columbus, Indianapolis, and Terre Haute to St. Louis. As soon as it was built emigrants from the east came by wagons with all their goods to settle in these states, and goods were sent in great wagon loads to the east. As the country was settled up roads were opened through the forest in all directions, and the swampy lands were crossed by means of corduroy roads, consisting of logs and boards laid crosswise of the wagon path in swampy places. It caused very rough riding, but was better than miring in the mud.

The early pioneers in the great forests of Indiana had another enemy in the shape of fever and ague and other diseases of a wet, malarial country. Much of the land was swampy and covered more or less with stagnant water, which the forests prevented from evaporating. Oftentimes no physicians were to be had, as the settlers were widely scattered; there were few towns, and medicine was hard to get. The milk sickness, supposed to have been caused from drinking the milk of cows that had fed on some poisonous plant, was a great plague. Fevers, agues, and bilious complaints were very common, and the settlers used quantities of quinine as the great remedy. As the forests have been cut away and the wet and swampy places drained out, the country has become much more healthful.

In order to secure a better outlet for trade great canals were dug connecting Lake Erie on the north with the Wabash and Ohio on the south. The farmers living near the canal could ship their grain and meat much cheaper to Buffalo or Cincinnati or New Orleans, and new settlers could bring their goods by canal.

The wagon roads were constantly improved. Gravel roads and turnpikes began to be built more than sixty years ago. If we visit the county towns (county seats) in Indiana to-day, we shall find a set of well-gravelled roads, smooth and solid even in muddy and wet weather, reaching out into the country and enabling the farmers at all seasons to haul heavy loads to the markets or to use their carriages in travel. These gravelled roads have been a great expense to the farmers and townspeople, but they are of great value for trade and travel.

Between 1830 and 1840 railroads began to be built in

Indiana and Ohio, especially those running east and west, connecting the eastern states with the western. When Indianapolis was first laid out in the centre of Indiana it was in the midst of the forest. The White River, near which it stood, was not large enough for navigation, and

FIG. 41.

A lumber camp in the Ohio Valley.

roads had to be built to connect the city with Cincinnati and other cities. When the railroads were built Indianapolis became a very important centre for the trade of the whole state. All the railroads from different directions meet in one great depot, which has come to be one of the greatest railroad centres in the world.

The forests of Indiana have always been of great value to the state. In the early settlement they furnished building materials for houses, barns, bridges, roads, fences, and for furniture, wagons, etc. Later the forests have been cut down for lumber such as poplar, hickory, oak, walnut, maple, beech, and sycamore. The forests still furnish a large amount of hard-wood lumber for the great factories and car works in Chicago, Indianapolis, Nashville, and other cities, but in many parts the finest lumber trees have been cut down, and what are left have an increased value. The black walnut, for example, once abounded in these forests, but most of the walnut trees have been cut down and made into lumber for sewing machines, organs, tables, desks, and other furniture.

Indiana was only a part of the great hard-wood forest region lying on the western slopes of the Alleghany Mountains and stretching away hundreds of miles to the prairies of Illinois and Missouri. The early settlers who first crossed the mountains into the Ohio Valley, and then floated for hundreds of miles down that stream, must have felt that the forest was endless. They began to cut down and clear away the great trees as if it would be impossible for the supply to give out. West Virginia, Pennsylvania, Ohio, Kentucky, Tennessee, Indiana, and part of Illinois and Missouri were covered by these great stretches of forest. All the country drained by the Ohio and its tributaries, the Muskingum, Scioto, Wabash, the Kanawha, Kentucky, Cumberland, and Tennessee, the Allegheny and Monongahela, was an almost unknown woodland. In those early days it was full of game, and dangerous because of Indians. Buffalo, deer, wild turkey, beaver, raccoon, bear, squirrel, pigeons, and other wild fowls and animals were abundant.

At Marietta, the first large settlement in Ohio, Mr. King says (American Commonwealths, "Ohio," p. 201): "Whatever their privations and dangers, the adventurers were spared any fears of famine. Their fields and gardens were not only fruitful beyond their utmost expectation, but the abundance of fish, flesh, and fowl was simply prodigious. Buffalo, deer, and bear seemed to wait upon them. Geese, ducks, and pigeons swarmed. The fish fairly infested the rivers, and were of such superlative size, that if the accounts of them were not proved by good evidence, they might be set aside as fish stories. Colonel May says that a pike weighing one hundred pounds was served up at a fourth of July barbecue, and catfish of sixty and eighty pounds were often caught."

But the appearance of this heavily forested region has changed greatly during the last hundred years. The wild game is mostly gone. The forests themselves have largely disappeared, and great fields of corn, wheat, oats, meadow and pasture lands now stretch away where once stood mighty trees so thick that their shade darkened the ground. The swamps have been drained, roads and bridges built, cities and towns are thick, and the railroads extending in every direction cover the land with what appears on a map as a network of lines and crossings. Great cities like Indianapolis, Nashville, Columbus, Cleveland, Cincinnati, and Louisville have become the homes and trading places of hundreds of thousands of people where a little more than a hundred years ago there were no inhabitants at all, only forests and wild game and wilderness.

In our day the serious question is not how to get rid of the forests, as with our grandfathers sixty years ago, but how to save them. The forests have been cut down too

much, not only destroying much valuable lumber, but changing the climate and causing the rivers to flood their banks in spring. The forests no longer hold the water back but it runs off too quickly in the springtime. The question of the future is therefore largely to protect the forests, to plant out trees, and to provide for an extension of the forest area.

It will be of special interest to compare the forest area of the pineries of the northern states with the hard-wood forest region of the Ohio Valley. Which has the greater extent? The appearance of the forests in the two sections is very different. After the pine forests are cut down in the north, a sandy, somewhat barren soil is left, while the soil of the hard-wood region is strong and fruitful. A comparison of the hard-wood forests with the prairie region of Illinois, Iowa, etc., will also be of interest. The black soil of the prairies is contrasted with the lighter loam and clay of the forest belt.

REFERENCE: King's "History of Ohio," American Commonwealths.

FIG. 42.
The Ohio River.

THE OHIO RIVER VALLEY

THE Ohio River, called by the early settlers the Beautiful River, has its sources high among the western slopes of the Alleghanies. The great tributaries on the south, from Kanawha to the Tennessee, drain the whole western slope of the Alleghanies as far as Alabama. On the north, the watershed between the Ohio branches and the Great Lakes is almost as low as between the Upper Mississippi and the Lakes. When the white men first penetrated the Ohio Valley, in the days of Daniel Boone, it was covered with mighty forests of hard-wood trees, stretching away hundreds of miles to the Mississippi River (see previous topic). The buffalo, deer, bear, wild turkey, squirrels, and other game abounded. The axe of the pioneer and woodman has long since cleared away a large part of these grand old woods, and changed them into fruitful fields and farms.

The Ohio River Valley naturally falls into three divisions. The first is the mountain district drained by the

Allegheny and Monongahela and their branches. The Allegheny River rises in Lake Chautauqua, only eleven miles from Lake Erie, and descends through long, narrow valleys to its junction with the Monongahela. To one travelling through this valley now, it is chiefly remarkable for the huge oil-tanks and thousands of oil-wells which have made this region so famous for the production of petroleum and its by-products.

The Monongahela, likewise, has worn a deep and narrow valley between the long mountain ridges. In many places the steep, rocky walls, from two hundred to four hundred feet high close to the river banks, give the appearance of cañons. The rock strata along this river are full of the coal measures, and the coal is seen cropping out between the layers of rock. Many coal-mines are run back horizontally into the mountains, and the coal is hauled out and dumped into the coal-barges which line the shore. This river is supplied with a series of dams and locks and with slack-water navigation like that on the Illinois River. Rafts of logs also float down from the mountains to the sawmills below.

At the junction of the two rivers lie the cities of Pittsburg and Allegheny, famous as centres for the iron business, also for oil and glass. Not only at the junction of these rivers are there great iron works, tall chimneys smoking day and night, and flashes of lurid light from the huge converters, but up and down the valleys of these rivers for many miles, at Braddock, Homestead, and McKeesport, at Sharpsburg, and even to Wheeling and other cities, the great factories carry on their work of manufacturing iron and glass. Large quantities of coal and iron are found in the mountains of western Pennsylvania, while the rivers

and railroads following the valleys bring in the raw products for these huge factories. All these rivers and their larger tributaries supply the deep valleys through which railroads can be built into such mountain districts. During the winter the coal-barges are filled with coal at the mines, and as the spring floods swell the Ohio, a great fleet of lumber rafts from the mountains, coal-barges, and

FIG. 43.

Towboat with fleet of empty barges going up the river.

steamboats, is sent down the river to distribute these products through the Ohio Valley.

The middle division of the Ohio Valley lies between Pittsburg and Louisville, and is a hilly, upland region. The rivers flowing into the Ohio from the north, like the Muskingum and the Scioto, descend to the Ohio through deep valleys, with narrow flood plains, and most of the large cities are located at the outlet of these side valleys.

The rivers from the south, such as the Kanawha, Kentucky, and Big Sandy, come down from the western slopes of the Alleghanies, and cut deep, narrow gorges on their way to the Ohio. In this part of its course the Ohio is lined with high bluffs, which are still covered in many places with forests of hard wood and evergreen. The cities are located on the river benches, between the low water and the bluffs above. The main channel, or trough, of the river is below these benches. The benches are usually sixty or sixty-five feet above low-water mark, but the heavy spring floods sometimes fill the great trough, rise even above the surface of the benches, and carry damage to towns and fields.

The floods of the Ohio River are much dreaded, and are due in part to the removal of the forests, over vast areas, which once held the water in check and drained them off more gradually to the rivers. The difference between high and low water mark has been sometimes as much as seventy feet. During the dry summer the main stream of the Ohio is at times not more than two or three feet deep, and navigation is wholly interrupted.

At Louisville the river breaks over a series of limestone reefs, falling about twenty feet in three miles. In high water the rocks are covered, and boats pass down over these rapids easily, but in low water the rock ledges appear, and vessels must pass through the canal and locks at Louisville to avoid the rapids.

Below Louisville the bottom-lands widen out into a broad alluvial plain, the bluffs retreating back from the stream, much as in the Lower Mississippi. Low, wooded islands are seen in the lowlands, and several large tributaries enter this great valley from the north and south.

The Green River, which rises in the hills of central Kentucky, drains a region underlaid with carboniferous limestones, in which are found extensive caverns. The greatest of all these is Mammoth Cave, which has rooms and passages 150 miles in total length. The Green River draws some of its waters from underground streams of

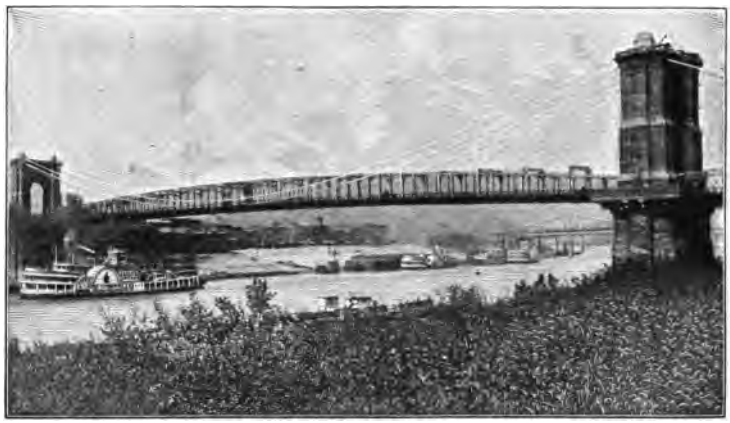


FIG. 44.

A bridge over the Ohio at Cincinnati.

this famous cavern. The regions of the Kentucky and Tennessee rivers have similar limestone rock strata, in which extensive caves are found. The great forests and decaying vegetation of these regions, by producing carbon dioxide, which was carried down into the rocks by rain-water, assisted greatly in dissolving the rock strata, and thus developing these extensive caverns.

The Tennessee River, the longest and largest tributary of the Ohio, has its sources far up among the mountain crests of Virginia and North Carolina. This river, following the

long valleys of the Alleghanies far southward into Alabama, instead of keeping on its course toward the Gulf of Mexico, cuts through the Chickamauga ranges by narrow gorges and is turned by a low mountain ridge westward in a grand curve. Then, unable to cross the low ridge between it and the Mississippi, it turns its course northward through Tennessee to Kentucky and the Ohio. Thus the whole western slope of the Alleghanies is drained into the Ohio River.

The Ohio Valley is, at the present time, the most important in point of population, cities, and wealth of any part of the Mississippi Basin. Originally one vast hardwood forest, it is still rich in timber lands, especially in Kentucky and Tennessee and West Virginia. The large coal and iron fields of Pennsylvania, West Virginia, Kentucky, and Tennessee, as well as of the Ohio and Indiana, are of vast importance. The tobacco regions of Kentucky and Tennessee, as of Indiana, centre mainly in the city of Louisville. In agriculture, Ohio, Indiana, Kentucky, and Tennessee have very rich resources and productions.

This region comprises a large number of great cities: Pittsburg, 315,000; Allegheny, 125,000; Cincinnati, 405,000; Louisville, 225,000; Nashville, 100,000; Columbus, 135,000; Dayton, 85,000; Covington, 50,000; Newport, 30,000; Wheeling, 40,000; Chattanooga, 40,000; Knoxville, 50,000; Indianapolis, 169,000. Seven of these cities have more than 100,000 people each. If we compare these with the cities of the Upper Mississippi, a marked difference is seen: St. Paul, 175,000; Minneapolis, 200,000; Dubuque, 50,000; Des Moines, 70,000; Peoria, 70,000; La Crosse, 30,000; Davenport, 42,000; Quincy, 45,000.

As compared with the Upper Mississippi, the Ohio is used much more for commerce, although the floods and drouth along the Ohio are more extreme. Pittsburg and Allegheny, at the head of the Ohio, correspond well with St. Paul and Minneapolis as centres of trade, though one is a level country and the other in the edge of the mountains. The coal, iron, and petroleum of the Upper Ohio

FIG. 45.

An Ohio River steamboat.

are as important as the wheat and lumber of the Twin Cities.

In the early settlement of the Ohio Valley, more than one hundred years ago, the Ohio River and its chief tributaries were the great highways of travel. From Pittsburg the eastern settlers went down the Ohio in boats and settled at Marietta, Cincinnati, and many other places. As there were no good roads through the vast woods, no railroads or canals, the river became extremely important, and the main channel of the Ohio was thronged with boats and steamers.

The early settlers at Nashville came in boats from east Tennessee down the whole length of the Tennessee River to the Ohio, and up the Cumberland to Nashville. To assist navigation before railroads became important, three different canals were built connecting the Ohio River with Lake Erie; one along the Scioto River, one from Cincinnati northward along the Miami and Maumee, and one by way of the Wabash.[1] Parts of these canals are still in use,

FIG. 46.
Marietta, the oldest town in Ohio.

but the building of numerous railroads has greatly diminished water traffic both on the Ohio and larger rivers and on the canals. The building of the canal around the falls at Louisville and the construction of dams and locks in the Monongahela and other rivers have greatly improved the navigation of these channels.

Some of the most interesting stories in American history

[1] Beginning in 1826, 658 miles of canal were built in Ohio at a cost of $14,688,000, besides improvements in the river channels by means of dams, feeders, etc.

are those of Boone, Robertson, and Sevier, who climbed over the Alleghany Mountains from Virginia and North Carolina and descended into the great forests and hunting-grounds of Tennessee and Kentucky. This region, so beautiful and delightful to the hunter and pioneer, was also known as the "dark and bloody ground," on account of the fierce conflict between the northern and southern Indians among these forests. As the white men began to settle in these ancient hunting-grounds of the Indians, many bloody conflicts were fought between them. The Indians north of the Ohio often crossed into Kentucky and attacked the forts which Boone and others had built on the banks of the Kentucky and other rivers, killing and capturing men, women, and children.

During the Revolutionary War the English combined with the northern Indians to make trouble for the Kentucky settlers. Then George Rogers Clark, with his backwoodsmen from Kentucky and Tennessee, descended the Ohio in boats, captured Vincennes and Kaskaskia, and compelled both the Indians and English to make peace and acknowledge the power of the Americans far north of the Ohio River.

In the same way, the southern Indians, Cherokees and Creeks, were aroused against the early settlers of Tennessee, but under the leadership of Sevier and Robertson the Indians were defeated.

The region of Pittsburg and Monongahela had been made famous before the Revolution by Washington's journey to the French posts from Virginia, and later by Braddock's defeat and the final capture of Fort Pitt by the English and Americans at the close of the last French and Indian War.

Up to the time of the Civil War, in 1861, the Ohio River was the boundary line between the free states and the slave states. Negroes held in slavery in Kentucky often escaped across the Ohio and with the assistance of friendly whites made their way across Ohio to Canada. This gave rise to what was known as the underground railway, as the fugitives were carried northward secretly, often at night.

During the Civil War the valleys of the Tennessee and Cumberland were made notable by important battles as at Fort Henry and Fort Donelson, Pittsburg Landing, Chattanooga, Knoxville, and Nashville.

Instead of reviewing the facts of the Upper Mississippi and of the Ohio Valley separately and by merely repeating them for each, it will be advantageous to review them together, comparing them, item by item, as follows: —

Which has the larger area, the Upper Mississippi or the Ohio? Compare the states drained by the one and the other together. Which has the larger or more important tributary streams? For example the Tennessee River is 1200 miles long, the Illinois is 500 and each is navigable about one-half of its length. Which has the greater forest areas, the Upper Mississippi or the Ohio Valley? What are the great agricultural products of the two sections? How do the chief cities of the Ohio Valley compare in size with those of the Upper Mississippi? There are seven cities in the Ohio Valley with 100,000 or more population each, and with a total population of 1,505,000. In the Upper Mississippi Valley there are but two cities, St. Paul and Minneapolis, with more than 100,000 each and the sum of their population is 375,000. An examination of these figures will show that along the Ohio River

there is a much denser population than along the Mississippi. Why? Which of these valleys has greater scenic attractions, and more places of historical interest? In the Ohio Valley are the mountain gorges of the Allegheny and Monongahela, the Kanawha, Cumberland, Tennessee, and other rivers rising in the western ridges of the Alleghanies and Chautauqua Lake; there are also Mammoth Cave, the falls at Louisville, the bluffs and hills along the Upper Ohio, the Indian mounds, the valleys of eastern Tennessee and middle Tennessee, Chattanooga and Lookout Mountain, Fort Donelson and Fort Henry, Cumberland Gap, and other places of historical interest. Along the Upper Mississippi are Lake Pepin, Fort Snelling, Minnehaha, the falls at Minneapolis, the lake region at the sources of the Mississippi, Mille Lac, the dalles of the Wisconsin, the great pipe-stone quarry, and the bluffs along the Mississippi; also Starved Rock, Utica, and Peoria along the Illinois.

MINNEAPOLIS

WHY has Minneapolis grown in a few years to be such an important city? It is but ten miles from the centre of Minneapolis to the centre of St. Paul, and the city of St. Paul was large and prosperous as a trading point and capital long before Minneapolis was thought of. In 1849,

FIG. 47.

St. Anthony Falls, in the Mississippi, around which Minneapolis has grown. These falls furnish power for a number of great flour-mills.

the first settler staked off his claim at Minneapolis near the falls. In 1890 the city had 164,700 people. This is a very marvellous growth and must be based upon very important and far-reaching facts. St. Paul, for many years in its early history, was a place for the white settlers and traders to meet the Indians. Before the war the agriculture of Minnesota was not much developed, and the lumber business also was scarcely begun. But when railroads began to reach out to the prairie regions west of Minneapolis and St. Paul, and as great numbers of settlers came

in from the eastern states and the Scandinavians and Germans from Europe, Minneapolis began to grow.

The falls at St. Anthony were long noted for their beauty and grandeur before cities grew up beside them. Of course the water-power was looked upon as of great value and when the pine logs began to be cut out of the northern forests and floated down the upper river, it was found that these falls were the best location for mills to saw up the logs. At first the water-power was chiefly

FIG. 48.

Lumbermen engaged in floating logs down-stream from the forest.

used by the sawmills, and as the prairie regions to the west settled up there was more demand for lumber for building purposes. In order to distribute this lumber and other products of the prairie country to the west, railroads were built branching out from Minneapolis. As this business of logging and lumbering grew, the whole Upper Mississippi with its tributaries became a network of rivers and logging camps for collecting logs to the mills at Minneapolis and other mill towns on the river. The large lumber firms had big sawmills at Minneapolis and

thousands of acres of timber lands in the woods to the north, with their lumber camps in winter and their rafting steamers for guiding the log rafts south at the time of the spring floods. Many of the wealthiest men and companies of Minneapolis and other river cities have acquired their fortunes in this business and have built them splendid homes in St. Paul and Minneapolis. Closely connected with the sawmills are the planing-mills for preparing dressed lumber, doors, sashes, and interior finish. Large

FIG. 49.

Logs in the river near Minneapolis. One of the bridges across the Mississippi River at this point is seen in the background.

factories were also established for the manufacture of furniture, agricultural implements, wagons and carriages, cooperage, and other kinds of woodwork. All these lumber products were then shipped westward over the diverging railroad lines into western Minnesota, the Dakotas, Iowa, and Nebraska. This rapidly growing prairie region, extending even to the Rocky Mountains and from Missouri to British America, demanded a vast amount of lumber for its rapidly developing cities and farms. It is evident, therefore, that Minneapolis, because of its position on the river, water-power, and mills, should soon be the great cen-

tre of the lumber business of the northwest. It collected logs from a large forest area on the Upper Mississippi, worked over this raw material in the sawmills, planing-mills, and furniture and other factories, and, by means of the many railroad lines spreading out westward, distributed this vast product over a very extensive region of prairie country. It is also clear that this important lumbering industry led thousands of people to find homes in Minneapolis and to build up the city.

As western Minnesota was rapidly settled up with industrious farmers, who raised great fields of wheat, oats, barley, corn, and other grains, besides thousands of cattle and hogs, they naturally shipped their grain and other produce over the railroads to Minneapolis. It was not long before the rich soil of the western prairies and river valleys was found to be one of the best and largest wheat-growing regions of the world. Not only are the rich upland prairies of southern and western Minnesota very fruitful in grain, where thousands and even millions of acres are yellow with waving grain in July, but the Red River Valley of the north is extremely fertile and favorable to wheat. "Close to the doors of the Twin Cities lies this Red River Valley, considered by some the third richest agricultural region in the world. It takes in many counties of western Minnesota and the eastern counties of the Dakotas. It reaches up into Canada beyond Winnipeg, and its southern end is the richer. It is a level prairie land of black soil that once formed the bed or deposit of an ancient sea. This region pours its wealth of grain into the two cities, there to exchange it for merchandise. The farmers sometimes have raised enough grain in one year to pay for their farms. One farmer made $30,000 in one season."

There are 8,832,000 acres in the valley, and in 1891 only about one-third was under cultivation, not all in wheat, but 30,000,000 bushels of wheat were grown, worth about $27,000,000. Most of the wheat of the northwest finds its way to Minneapolis, where the big mills convert it into flour. In 1871 only two car loads of wheat were received in Minneapolis. In 1887 the Great Western Railroad brought 33,000,000 bushels to the flour-mills. Of course a large part of this wheat was ground up into flour, put in sacks or barrels, and shipped eastward by way of Duluth and the lakes, or by way of Chicago, to New York and eastern states. A very large part of the flour made in Minneapolis is sent in ship loads to Liverpool or Hamburg, in Europe. The great railroad lines from the Twin Cities to Duluth and Chicago send long train loads to the east and to Europe, where millions of people make bread from Minneapolis flour.

FIG. 50.
The Pillsbury-Washburn flour-mills at Minneapolis.

It is found, therefore, that Minneapolis is the great centre of trade and manufacture in a second important staple product, *wheat;* that it collects this product from a broad area by means of railroads, manufactures it in the big flour-mills, and then distributes it over the eastern states by means of railroads and water ways, and even sends

millions of dollars' worth of food to England, Germany, and other European countries. This vast business of wheat and flour milling also collects thousands of people in Minneapolis, who build homes there, and many of the wealthy men of the northwest have based their fortunes upon this great business.

There is still a third line of business in Minneapolis that is as important as the two already described. Manufactured goods of all kinds, as dry-goods, machinery, clothing, instruments, tools, paper and books, medicines, groceries, china and porcelain, hardware, farm implements, cutlery, and a hundred other important manufactures of the eastern states and Europe are shipped to the trading and wholesale houses of Minneapolis and St. Paul, whence they are sent out over the railroads and distributed to the prairie and even mountain regions to the west and northwest. This immense trade centres in Minneapolis and St. Paul, which thus make a great depot for the collection and distribution of products. The handling, sale, and shipment of all these manufactured goods call another large class of people to the Twin Cities, and give the great railroad lines a large share of their business.

As a result of the description of the lines of trade and commerce centring in Minneapolis, we are able to see partly the reason for its rapid growth and its great importance. It is easy to see that Minneapolis not only has a fine location on the river, which naturally makes it the centre of the lumber trade, and a vast water-power that makes milling cheap and profitable, but that by means of the river and the railroads it is brought into the closest relations with the extensive pineries of the north, the fertile prairies and river valleys of the northwest, and with

the great centres of manufacturing and population in the east. The lake ports, Duluth, Milwaukee, and Chicago, enable it to send goods with small expense to New York and Europe. The Mississippi River on the south brings St. Paul in close communication by boat and cheap freight with the whole Mississippi Valley from Louisiana to Pittsburg and Kansas City and farther. In early days this connection of St. Paul with the river was very important, as nearly all heavy goods reached St. Paul by boat, but since the railroads have become so important the river trade has grown less.

We have already seen that Minneapolis was a natural centre for the manufacture of lumber and flour, but after these great industries were well started, many other large manufacturing plants became established, such as boot and shoe factories, furniture and wagon shops, smelting works, packing houses, and car works and machine shops, as well as many smaller manufacturing industries. The result is, that though of so short a growth Minneapolis has already become a centre for very large manufacturing interests, and the products are shipped to the broad regions of the west that Minneapolis supplies. These industries also have contributed to the rapid growth and wealth of the city. It should be remembered also that hundreds of thousands of settlers, seeking farms and homes, have come from New England and the northern states as well as from England and Scandinavia to develop the country and increase its population and wealth.

Besides all these wide-reaching influences, the city has a beautiful and elevated location above the river, with the best of drainage, with a natural forest that still shades of the city, and half a dozen beautiful lakes and fine

parks within the city limits or near them. The streets of the city have been laid out on a broad, liberal plan, and the street-car service is excellent. Many very fine public buildings and business blocks adorn the principal streets. The public library, with forty thousand volumes, is an elegant and imposing structure. The Guarantee Loan Building, fourteen stories high, is one of the finest buildings in America. The State University, on the east bank of the river, and other public institutions are on the same grand scale. It is a very healthy city, and is especially noted for its great number of pleasant homes.

The city of St. Paul, only ten miles away, is not excelled by Minneapolis in progressive spirit and enterprise. It is especially the centre of the wholesale trade of the northwest, and has excelled Minneapolis in the extent and variety of manufactures. Some of its streets of elegant residences along the bluff are among the finest in America. Its business streets near the river are somewhat narrow and cramped, but farther up along the bluffs the city is laid out on a generous plan.

It has been thought that these two cities would some day join their forces and make one great city. Already their suburbs touch each other, but the rivalry between them is very lively and sometimes bitter. It is estimated that before many years the two cities will contain a million people.

In conclusion, it will be profitable to compare Minneapolis and St. Paul with other great centres of trade in our own country which are somewhat similarly located. Pittsburg and Allegheny city, especially, at the head of regular steamboating on the Ohio, may well be compared with the Twin Cities of Minnesota. Pittsburg is also the cen-

tre of vast exchanges of raw products and of manufactures from these products. Water and railway traffic are also equally well illustrated. Minneapolis and St. Paul are far away from the coal supply, and that has somewhat hindered the growth of manufactures. How is coal obtained cheapest in St. Paul and Minneapolis? It may be well also to locate on the map carefully the great wheat and lumber districts that are tributary to St. Paul and Minneapolis and to draw in outline the states included. Compare these also with the corn belt and the prairie regions farther south. Kansas City is also a place of modern growth that may well be compared as to its advantages with Minneapolis. It also controls the trade of a large area and collects and distributes products on an extensive scale. Later, when we come to study the eastern states, the Twin Cities may also be compared with Albany and Troy, at the head of navigation on the Hudson.

A full and detailed description of a single great trade centre like Minneapolis will enable the children to see the causal influences which have really produced a great city. The lines of traffic cross each other in different directions, and they see that where raw products are collected in such vast quantities manufacturing naturally follows. Minneapolis is an excellent type of these things, and stands out with sufficient distinctness to make these ideas apparent. As they study other cities in their later lessons they will be inclined to look for the causes which make and keep alive the importance of great cities.

REFERENCE: *Harper's Magazine*, March, 1892, "The Capitals of the Northwest."

LAKE SUPERIOR

"LAKE SUPERIOR is the largest lake in the world, and the largest body of fresh water. It is 380 miles in length, and 160 miles across at the widest part. Its watery area of 32,000 square miles proves it to be the size of the state of Indiana, or four times as big as Massachusetts. It is about 600 feet above the sea-level, but the government charts show that in its deepest parts the water has a depth of 1386 feet, so that there, at least, the bottom of the lake is more than 700 feet below the level of the sea. North of Keweenaw Point, on the south side, there is a depth of 1008 feet, and great depths, above 500 feet, are scattered all about the lake. Its shore line is 1500 miles in length."

The lake fills a great basin, which has a high, rocky rim all about it. The short, steep slope is toward the lake, while the long, gradual slope, after reaching the summit of the ridge, is away from the lake. More than 200 small rivers pour their waters into Lake Superior, but they are mostly short, with swift, foaming currents as they come tumbling over the rocks, down the steep slopes of the country surrounding the lake. These rivers are not large and smooth enough for boating, but they supply splendid water-power for mills, which will be used in time. The St. Louis River, at the head of Lake Superior, is one of the largest of these streams, and is often spoken of as the source of the St. Lawrence. This river makes some big leaps and falls as it descends

the rocky ledge between the plateau of Minnesota and the lower level of the lake. The rivers tributary to Lake Superior drain a territory of 53,000 square miles, or nearly as large a space as Illinois.

The shores of the lake are very rocky, and only in a few places are there sandy or level beaches, especially along the southern shore. Along the north shore the steep, rocky cliffs rise a thousand feet or more above the water, and the lake is deep at their base. There are also many deep bays and harbors along this northern shore. The steep cliffs and deep water and bays of this northern coast make the shore scenery of the lake grand and impressive like that of the ocean on rocky shores. Along the central part of the southern shore, where the lake is widest, are the high sandstone cliffs known as the pictured rocks. As the winds and storms of the north drive across the lake, the great waves beat upon this southern shore with much fury and have washed out and chiselled the rocks into many curious and interesting shapes. The sand and gravel have also been piled up beyond the shore

FIG. 51.
Wave-cut cliff with beach in small bay, Lake Superior.

line in white hills two and three hundred feet high. The shores on all sides are clothed with dark evergreen forests, which extend far northward into Canada and southward into Wisconsin and Michigan. As the shores for many miles are not settled, fine hunting is still met in these wildernesses of forests and streams.

"At present there are trout a plenty in the streams that flow into the great lakes through the beautiful forests which clothe that enormous tract, in which, south of Superior alone, there are said to be 500 or 600 little lakes. Exactly like it, from the sportsman's point of view, is the region north of the lake, where the land looks, upon a detailed map, like a great sponge, all glistening with water, so crowded is its surface with lakes and streams. In the north are the caribou and all the animals that the fur traders of the Hudson Bay Company value. South of the lake there are no animals larger than the deer, but deer are abundant and bear are still numerous. In the fishing season a man may feast on trout, black-bass, pickerel, maskalonge, partridge, venison, and rabbit.

"The city of Marquette, on Iron Bay, in the centre of the most picturesque part of the south shore, gets its importance as a shipping port for ore and lumber, but it occupies the most beautiful site and is the most beautiful town, as seen from the water, of all those that have grown up on the lake. It has a large and busy trading district on the sandy shore of the lake, but the fine residence districts surmount a high bluff which half encircles the town. Ridge Street, two hundred feet above the lake, may easily become one of the finest avenues in America, and already it numbers some of the most artistic and costly houses in the Lake Superior region. With its drives

and neighboring forests, with its fishing streams and lake, it deserves to rank as a summer resort." Presque Isle Park, on a high rock promontory overlooking the lake, with a forest above and the steep rocks below, is hollowed out into caves which a boat may enter from the lake. The Pictured Rocks also are only a short distance east of Marquette, so that this entire region is one of great interest. This southern shore is also very important on account of the great iron mines in the Marquette range (seventy-two in number) and the large copper mines in the Keweenaw peninsula. The largest ore docks in the world are seen at Marquette.

There are also many islands in the lake which add to the interesting scenery. "Numerous islands are scattered about the north side of the lake, many rising precipitously to great heights from deep water, some presenting castellated walls of basalt, and others rising in granite peaks to various elevations up to 1300 feet above the water" (Encyclopædia Britannica). The northern shore is also rocky and steep. "Its famed and stately walls of rock delve straight downward into the water and rise sheer above it without giving nature the slightest chance to make a litter of dirt and rocks at their feet. While other rocky shores of other waters stand apart or merely wet their toes in the fluid, those monsters wade in neck-deep and only expose their heads in the sunlight, sometimes 200 fathoms from the bottom. Terrible prison walls these become to the shipwrecked mariners, for they extend in reaches sometimes twenty-five miles long without offering a finger-hold for self-rescue. The largest of the islands is a part of the United States. In fact the greater part of the lake itself belongs to the United States, although the northern part goes with Canada."

The fisheries form an important business on the shores and islands. "The lake and the vast region around it are the sportsman's paradise and a treasury of wealth for those who deal in the products of the wilderness, — furs, fish, and lumber. At little Port Arthur alone (on the north shore) the figures for the fishing industry for the market are astonishing. In 1888 the fishermen there caught 500,000 pounds of whitefish, 360,000 pounds of lake-trout, 90,000 pounds of pickerel, 48,000 pounds of sturgeon, and 30,000 pounds of other fish, or more than a million pounds in all. They did this with an investment of $3800 in boats and $10,000 in gill and pound nets. This yield nearly all went to the Chicago Packing Company, and it is in the main Chicago and Cleveland capital that is controlling lake fisheries. The whitefish, in the opinion of many, is the most delicious fish known to Americans. The lake-trout are mere food; they are peculiar to our inland waters, they average five to ten pounds in weight, and yet grow to weigh a hundred and twenty pounds" (*Harper's Magazine*).

The fish are caught in nets, and, by the use of small-meshed nets, the fishermen claim that millions of small fish are killed each year and the fishing is thus being seriously damaged. The fish commission has been trying to cultivate greater numbers of the best fish by putting "fry" yearly into the lakes. This, however, it is claimed, does not repair the damage done by the use of small-meshed nets.

The water of the lake is clear and cold at all seasons. It is almost ice cold in summer, so that sailors and fishermen are quickly chilled by falling into it; but in winter it does not freeze over, so great is the quantity of water and so slowly does it change its temperature. The water is so

clear that one can easily see objects at a depth of twenty feet, and the sailors claim even to a depth of forty feet. When the water is shallow it is distinctly green ; but in deep waters it changes to blue when seen at a distance, and it has varied hues and colors according to the changes of the atmosphere and sunlight.

"One peculiarity of Lake Superior cannot be too strongly dwelt upon or exaggerated. That is its purity, — the wonderful clearness and freshness of it and of its atmosphere and of its borders. It must become the seat of a hundred summer resorts when the people visit it and succumb to its spell." Already two of its summer resorts have become famous, Munising and Nepigon, while there is room and opportunity for many more along its fifteen hundred miles of rocky and forest-covered coast-line.

FIG. 52.
A lake steamer.

Within the last few years the commerce of the lake has grown into very great importance. The lake surface lies twenty-two feet higher than Lake Huron and Lake Michigan, and until a canal and lock were built to connect the commerce of Lake Superior with that of the other lakes little could be done to develop the trade of Lake Superior's cities. "As originally built, the canal in St. Mary's River was a mile long, had a width of one hundred feet at the water line, and a depth of twelve feet. The locks were two in number, each three hundred and fifty feet in length, seventy feet in width. At the time the

canal was made these dimensions were sufficient to pass any vessel on the lakes fully laden, but by 1870 it became necessary to provide for more rapid lockage and for the passage of larger vessels. Accordingly the old canal was widened and deepened and a new lock constructed five hundred and fifteen feet long and eighty feet wide. There is now everywhere a navigable depth of sixteen feet from Lake Superior to Lake Huron. In 1883 the registered tonnage passing the canal was 2,042,295 tons."

"The date of the last enlargement of the lock is the date upon which to base all computations as to the lake traffic. The lock was enlarged and newly opened in 1881. Marquette, the 'Queen City of Lake Superior,' is an old place of former industry, but it is a mere baby in its present enterprise. Superior dates from 1852 'on paper,' but from 1881 in fact, while Duluth is only a few years older. Port Arthur, the principal Canadian port, owes itself to the Canadian Pacific Railway, now about seven or eight years of age (1892), and many of the future cities are not yet discovered" (*Harper's Magazine*, April, 1892). The Canadians have also built a canal on their side of the strait, so as to be independent of the United States. In 1890, 9,000,000 tons of shipping passed through the strait. But the increase of shipping was so great that Duluth and other lake ports were greatly dissatisfied because of insufficient lockage. In 1890 the depth of the water in the canal was from $14\frac{1}{4}$ feet to $15\frac{1}{4}$ feet. The new government lock, built at a cost of $4,000,000, is 100 feet wide, 21 feet deep, and 1200 feet long. On account of an accident to the old lock it was closed for a short time. It cost the companies who use the canal, a loss of $1,000,000 and delayed about 183 vessels each way.

Since 1881 a vast commerce has developed on Lake Superior. The great iron and copper mines all along the shores in Minnesota, Michigan, and Wisconsin, the wheat and other grains from the prairies of the northwest, loaded into ships at Duluth and Superior, and the thriving cities that have sprung up like magic on the shores of this great inland sea, have produced an amount of traffic that is worth many millions of dollars. Duluth

FIG. 53.

A lake boat loading with iron ore at the docks.

has been regarded as a second Chicago and as a city with a great future. It lies much nearer the great wheat-fields than Chicago and 500 miles nearer the Pacific Ocean at Puget Sound. The Canadian and Northern Pacific railroads lead directly to Lake Superior at Duluth and Port Arthur.

The whaleback steamers at Duluth and Superior are loaded with wheat for Buffalo. One of them even passed through the Welland Canal and down the rapids of the St. Lawrence to Liverpool. The great ambition of the

Lake Superior cities is to secure a twenty-foot waterway from Duluth to the Atlantic Ocean, so that large vessels of 6000 tons burden can sail directly for Europe. From Marquette, Duluth, and other cities of Lake Superior, there are shipments every year of millions of tons of iron and copper ore, and of wheat. The lumber trade through the canal is also very important and the shipment of coal from Pennsylvania to Duluth and Superior supplies the returning vessels a large part of their cargo. In this way

FIG. 54.

Lake vessels, the one in front being called a whaleback.

Minnesota secures a comparatively cheap supply of coal, although the distance from the coal-fields is great.

The season for navigation on Lake Superior lasts usually about eight months, from the middle of April to the middle of December. The sailor's life on the lake is a severe one. The storms are as rough as upon the ocean. In midwinter, although the lake is not frozen over, it is not navigable, as the shores are lined with ice for four or five miles out from the land. "There are two obstructions for which Superior is notorious and they rank next to the ice and still further limit navigation for some lines of

ships. These evils are the fogs and the snow-storms. Of these two the fogs are the more numerous and the snows the more dreaded. In the summer, Dame Superior wears her fogs almost as a Turkish wife wears her veils. There is a time in August when the only fogs are those which follow the rain, but the snow begins in September. The Canadian Pacific steamships are only in service from May to October, and it is the snow that curtails their season. It snows on the Great Lakes as it does on the plains, in terrible flurries, during the course of which it is impossible to see a foot ahead, or to see at all. It has a way of snowing on Superior as late as June and as early as September. As for the fogs, though they are light and often fleeting after midsummer, they are sufficiently frequent during the rest of the season of navigation to have given the lake a bad name among sailors, and I had a captain tell me that he had made seven voyages in succession without seeing any lights on his route from Port Arthur to the Soo."

FIG. 55.

A huge grain elevator near the waterway.

Great railroad lines extend now from east to west along both shores, the Canadian Pacific on the north and the "Soo Road" on the south. Freight is much cheaper by

water than by rail, and the freight rates by water compel the railroads to reduce their rates. "Those who have made the arguments for the various lake ports show that whereas in 1868 the rail rate on grain from Chicago to New York was 42.6 cents a bushel, it was 14 cents in 1885. The water rate fell in that time from 25 cents a bushel to 4.55 cents. It has kept from 25 to 67 per cent lower than the rail rate. The value of the waterways to the public is illustrated in a startling way by making use of the government records of the Sault Ste. Marie Canal traffic for 1889. There passed through that canal 7,516,022 tons, carried an average distance of 790.4 miles at 0.145 cents a ton a mile. The railroads would have charged 0.976 cents, and the business would have cost the public $50,000,000 more if the railroads had transacted it than was charged by the boatmen." This gives some notion of the vast amount of freight on our great inland lakes. Thirty-six millions of tons of freight passed through the Detroit River in one year, which is much greater than the tonnage of the ocean and gulf ports of the entire United States. A study of these trade routes from the Great Lakes to the St. Lawrence and the Hudson reveals the chief line of traffic in the United States, as well as between the United States and Europe.

After studying Lake Superior in detail it will be instructive to make a brief comparative study of the other Great Lakes, their shores and cities, their size and commerce. Any good cyclopædia will furnish sufficient data from which to compare the other lakes with Superior. The chief lake ports should also be studied and compared in their relative importance and advantage for trade. In Tilden's "Commercial Geography," pp. 74, 75, is a valuable

though brief treatment of the Nine Lake Ports (Leach, Shewell & Sanborn, Chicago).

In the later study of geography in America and in other continents such a knowledge of our Great Lakes, their extent, scenery, climate, commerce, and cities will be helpful and should be called up again in frequent comparisons.

THE SURFACE OF TENNESSEE

An examination of the map of the United States will show that Tennessee from east to west includes the whole slope of the Mississippi Valley, from the highest summit of the Alleghany range to the bottom-lands and swamps of the great river. In Tennessee and Alabama, also, we find the nearest approach of the mountains to the Mississippi.

Fig. 56.

Relief Map of Tennessee.

A study of the surface features of Tennessee not only shows some of the chief varieties of mountain and plain, and their agricultural and mineral products, but gives them in a series of parallel districts. The Tennessee River crosses the state twice from north to south, and with the Cumberland gives the state three distinct valleys, with the mountains or elevated ridges between.

The valley of east Tennessee is perhaps the most attractive part of the state to visitors and travellers. It extends from northeast to southwest across the state, and is drained by the Upper Tennessee and its branches. It is a long, narrow valley, somewhat rough and irregular,

at its narrowest point not more than seven miles across and widening out to twenty-five miles. This valley has the range of the Great Smoky Mountains, or Unaka range, on the east, separating it from North Carolina, and the lower Cumberland Mountains on the west. This long valley is a continuation of the great Valley of Virginia, and was the home of the first settlers under Robertson and Sevier. It is somewhat elevated above the sea, and has a cool and bracing climate even in summer time. During the Civil War this part of Tennessee remained faithful to the Union, and was the scene of many battles of importance. Near Chattanooga the river breaks its way through the mountains and turns southwestward into Alabama. At this point are some noble bluffs and deep gorges, through which the river passes, and this was the centre of Grant's great movements at one period of the war. Both sides of this valley have abundance of iron ore, and many furnaces have been established for its reduction. Marble is also quarried along the valley, and has been much used in the United States for building purposes: as, for example, in the buildings at Washington. This great valley has been washed out during long ages by the waters of the Tennessee and its tributaries. The upper slopes of the mountains are covered with pine forests, which yield tar, pitch, and lumber. On the lower mountain slopes are groves of sugar-maple and other hardwood trees, and red cedar. The hills and mountain slopes afford abundant pasturage, but there is only a narrow strip of rich agricultural land. The coal-fields also extend along this valley, so that the iron ore can be smelted with [illegible]tained near at hand.

[illegible]een the valley of east Tennessee and the valley of

FIG. 57.

Lookout Mountain and the Tennessee River.

middle Tennessee, with Nashville as its centre, are the Cumberland Mountains and their projecting highlands toward the west and south. This mountain district is not so high as the Unakā range, and while most of the ridges extend from north to south, some are at right angles to this. "The Cumberland Mountains stretch

FIG. 58.

State Capitol, Nashville.

across the state from north to south, and in the middle of the state take a westerly direction, gradually diminishing into moderately hilly ridges, enclosing beautiful and fertile valleys. These mountains occupy in some places a breadth of fifty miles, and are a prolongation of the Alleghany range." This district of the Cumberland Mountains is really a plateau, rising in places to

three thousand feet, forty miles wide, and a hundred and forty long. It is underlaid with the coal measures, and above them lie the later rock strata that were formed above the coal-bearing strata.

In the north-central part of the state lies the rich and beautiful valley of middle Tennessee through which the

FIG. 59.
Carnegie Library, Nashville.

Cumberland River flows. Most of the country between the Cumberland Mountains and the Tennessee River of the west is hilly and broken, but the valley about Nashville sinks below the level of the surrounding ridges, and, in fact, is like a great basin with a rim of rocky highlands surrounding it. It is about two hundred feet below the level of the surrounding hills and was selected by the early settlers at Nashville for its fertility and rich promise. The soil of middle Tennessee, as it is called, is generally good, producing large crops of wheat and other

grains, hemp, flax, cotton, and tobacco. In this region, also, are splendid forests which have been more developed in recent years than formerly. The poplar, hickory, black walnut, oak, beech, locust, and cherry are found in abundance, both on the lower levels and on the uplands. The lumber industry of Tennessee has grown to much importance.

Nashville, Tennessee, has become noted as a beautiful southern city. It has a number of great schools and higher institutions and the state capitol, as well as a beautiful location on the river.

The district between the Tennessee and Mississippi rivers is more level and is a rich agricultural region. There are some low and swampy lands in the northern part, and along the lowlands of both the Tennessee and Mississippi are extensive cane-brakes, with tall canes of great size. The uplands produce cotton, tobacco, and grain in abundance. In the lowlands are large swamp cypress, sycamore, cottonwood, and swamp cedar. Memphis, on a bluff in the southeast of the state, is a great cotton market. It has been scourged twice with yellow fever, which was brought up the river in boats from New Orleans. Memphis is the chief river port between St. Louis and New Orleans. Much of the cotton collected here is shipped by rail to New York and other eastern cities. A bridge crosses the Mississippi at Memphis and connects with railroads to Kansas City and Little Rock.

The state of Tennessee is naturally a very rich country, with great forests and an abundance of coal and iron in its hills and mountains. It has also a rich soil and large navigable rivers which make shipments to the gulf or to the Ohio cheap. But since the war the resources of the state

have not been rapidly developed until the last few years. Large smelting, steel, and iron works have been established at Chattanooga and at Knoxville. Mills for the manufacture of cotton cloth have been established also, and northern capital and settlers are helping to develop the riches of the country. Large companies with extensive capital have bought up some of the best forest tracts and are developing the lumber business. Many varieties of excellent marble have been quarried in Tennessee and are shipped to other states.

One of the curiosities of the surface of Tennessee is the great number of deep and extensive caves found in the hilly limestone districts of this state. Several of them are miles in extent underground, with streams of water flowing through them.

Tennessee is as much broken up and irregular in its surface features as any of the states west of the Rocky Mountains. It will be well to have the children not only draw it in outline, locating the districts clearly, but also mould it in sand on the sand table and work out in detail its physical peculiarities, studying the maps for this purpose.

TRIP ON THE LOWER MISSISSIPPI

(From St. Louis to the jetties at the delta.)

A STEAMBOAT trip on the Lower Mississippi from St. Louis down to the mouth was formerly much more common and popular than now. The steamer itself is a grand affair with its great smoke-stacks from which issue clouds of black. A writer in *Scribner's Monthly* for October, 1874, thus describes a Mississippi steamer: "The *Great Republic* is the largest steamer on the river, literally a floating palace. The luxuriantly furnished cabin is as long and ample as a promenade hall, and has accommodations for two hundred guests. Standing on the upper deck or in the pilot-house one fancies the graceful structure to be at rest, even when going at full speed. This is the very luxury of travel. An army of servants come and go. As in an ocean voyage, breakfast, dinner, and tea succeed each other so quickly that one regrets the rapid flight of the hours. In the evening there is the blaze of the chandeliers, the opened piano, a colored band grouped about it and playing tasteful music, while youths and maidens dance. The twoscore negro 'roustabouts' on the boat were sources of infinite amusement to the passengers. At the small landings the *Great Republic* would lower her gang-planks and down the steep levees would come a procession of negroes and flour barrels. The pilots perched in their cosey cage, twisted the wheel, and told us strange stories."

Up to the time of the war the Lower Mississippi was the scene of great steamboat travel and traffic. The invention of the steamboat by Fulton was a great help to the early settlers of the Ohio and Mississippi valleys. Before 1817 there were 8 steamboats on the Ohio; in 1829 there were over 200 steamboats on the Mississippi; in 1842 there were 600 steamboats and 4000 flatboats; in 1847 there were 1190 steamboats, besides barges and flatboats on western rivers. These figures, though brief, show how trade and travel grew on our western rivers before the age of railroads. Vast quantities of goods were shipped on the rivers east and west, north and south. In 1842 it is estimated that $220,000,000 worth of goods were carried by the boats on western rivers. Immigrants with their families and household goods came west by boat and it was the common mode of travel for all. There was great rivalry of the companies in building splendid boats, and races up and down the river were common.

A trip in a steamboat nowadays down the Mississippi is not so exciting, and trade and steamboat life are not so brisk, and yet such a trip is perhaps the best means of getting some knowledge of our greatest river and the many curious and striking pictures it furnishes.

The main river really begins where the Missouri joins the Mississippi, and together they pour their vast flood down the broad valley. At Cairo, the southern point of Illinois, the Ohio adds its waters to the main stream, and from there on the current deepens, the valley widens, and the tarlike flood winds its crooked course for twelve hundred miles through the soft mud and bottom-lands, where no sign of rock is found in bank or bottom, but only the rich silt carried down by the river.

The distance between the bluffs is from twenty-five to eighty or even a hundred miles. From Cairo to Memphis the river hugs the Kentucky shore, leaving the earthquake swamp and sunken lands on the west side in Missouri and Arkansas. Below Memphis the channel crosses the lowlands to the other side and flows past the bluffs at Helena and the mouths of the White and Arkansas rivers. Then farther south the current of the river sweeps across the lowlands to the bluffs at Vicksburg, and does not return to the west bluffs. There are vast swamps and rich bottom-lands on the east side between Memphis and Vicksburg. Below Vicksburg there are extensive lowlands, bayous, and swamps on the west side. In the bottoms the land slopes down gradually away from the immediate banks of the river, so that most of the bottom-lands are below the level of high water, and are subject to floods unless the levees can be made strong and high enough to protect them.

FIG. 60.

The Lower Mississippi River.

Starting from St. Louis down the river in March, we have more than a week's quiet journey to New Orleans. It may be cold and wintry in the north, but there are great changes of climate before we reach the end. It grows warmer; we find the fields already ploughed and planted in Mississippi, and the trees are green. The swamp oaks festooned with gray moss give the lowlands a dismal look, and at this season the bottom-lands may be flooded. In places along the shore of Tennessee we see tall cane-brakes, and on the bluffs sometimes two and three hundred feet above the valley are perched the cities.

"A journey of twelve hundred miles was before us. We were sailing from the treacherous March weather of St. Louis to meet the loveliest summer robed in green and garlanded with fairest blossoms. Eight days of this restful sailing on the gently throbbing current and we should see the lowlands, the Cherokee rose, the jessamine, the orange tree.

"Our river pilot must be a man of great nerve and experience, not only knowing the channel and all its twisting courses, but able to detect changes in the shallows and currents, and skilful to guide the vessel even at night. Mark Twain, in his 'Life on the Lower Mississippi,' has given us a vivid picture of the pilot and of steamboat life at the time of its greatest importance.

"The pilots on the Mississippi and western rivers have an association with headquarters at St. Louis and branches at Pittsburg and other cities. Each of the seventy-four pilots on his trip makes a report of the changes or obstructions in the channel, which is forwarded from point to point to all the others.

"In March and April, when the snows and ice are melt-

ing and the spring floods come down from all the great tributaries of the Mississippi, the main channel below Cairo becomes a mighty torrent. It rises little by little till the levees can scarcely hold it back. These floods are not frequent, but in some cases they have been very destructive, and neither the owners of plantations in the great bottom-lands nor the government of the United States have been able yet to control the river at such times of danger.

"When the rains have swollen its tributary rivers to more than their ordinary volume, the Mississippi River is grand, terrible, treacherous. Always subtle and serpentlike in its mode of stealing upon its prey, it swallows up acres at one fell swoop on one side, sweeping them away from their frail hold on the mainland, while, on the other, it covers plantations with slime and broken tree trunks and boughs, forcing the frightened inhabitants into the second story of their cabins and driving the cattle and swine upon high knolls to starve or to drown. It pierces the puny levees which have cost the bordering states such vast sums, and goes bubbling and roaring through the crevasse, distracting the planters and sending dismay to millions of people in a single night. It promises a fall on one day and rises suddenly the next. It makes a lake of fertile country and carries off hundreds of woodpiles which patient labor has collected along the banks for the use of passing steamers. It makes islands of towns perched on the banks. As the huge steamer glides along on the mighty current we can see families perched in the second stories of their houses. At one point a man was sculling along from house to barn with food for his stock. The log barn was a dreary pile in the midst of the flood. The swine

and cows stood shivering on a pine knoll. As we passed below the Arkansas and White rivers, the gigantic volume of water had so far overrun its natural boundaries that we seemed at sea instead of upon an inland river. The cottonwood trees and cypresses stood up amid the watery wilderness like ghosts. Gazing into the long avenues of the sombre forests, we could see only the same level, all-enveloping flood. In the open country the cabins seemed ready to sail away, though their masters were usually smoking with much equanimity and awaiting a 'fall.'"

The levees built along the bank to keep the water in the main channel and prevent overflow begin above Cairo. This city is built on a flat, low plain, below the level of high water. The levees are strong at this point, so that the water does not flood the town, but it seeps through the banks and covers the lower ground, making it possible to pass through some of the streets in boats. The levees are designed not only to prevent the floods sweeping into the lowlands, but by confining the current they are expected to cause the waters to scour out a deeper channel. Before the war, when the planters were richer and could control their laborers to better advantage, the levees were better kept up and the lowlands protected; but since the war there have been several destructive floods, doing millions of dollars' worth of damage. There is a levee extending most of the distance from Cairo to Vicksburg on the east side. The national government has spent a good deal of money in surveying the river and in building and protecting the levees. One chief difficulty is the fact that the levees themselves have to be built of the soft mud and dirt, which the current of the river so easily washes away,

and the river is constantly eating into its banks and washing away at times whole acres of land.

Several of the most important cities we pass upon the steamer are situated high on the bluffs at the foot of which the river flows. The first of these is Memphis, on the fourth Chickasaw bluff, and not only holding a commanding position on the bluff, but a great centre of the Mississippi trade in cotton and tobacco. It is also an important railroad centre, because of its railroad connections with the west and southwest, and with the east.

Vicksburg, another "hill city," is on a great bend in the river. The steep streets run up to the terraces and bluffs and the city presents an imposing sight from the river. The bluffs run back to a higher plateau back of the city, and many fine residences are seen on the higher terraces. The old court-house occupies one of the highest levels, and the old fort, with its grass-covered ramparts, still stands on an eminence commanding the river, and bears marks of the memorable siege. From this old fort, high upon the bluffs, one can see the great bend in the river, the passing steamers and ferries, and the lowlands of the great loop, almost covered in high water. During the siege of Vicksburg, General Grant tried to turn the channel of the river at the time of the spring flood. In this he failed, but in later years the river itself made a cut-off, leaving the city of Vicksburg several miles away from the main channel. At the mouth of the Yazoo River is the great national cemetery where sixteen thousand soldiers lie buried, and twelve thousand of the graves are marked "unknown." Trees are planted, and the grounds are kept tastefully in honor of the soldiers who fell in the south. Oak trees have been planted and have grown

upon the spot, and vines have clambered upon them. A small marble monument marks the spot where Grant met Pemberton. Vicksburg was formerly the centre of a great steamboat trade with New Orleans, and is still important for the cotton trade.

Natchez also stands on high bluffs overlooking the river. It is one of the loveliest of Mississippi towns and was once the home of great wealth and of many cultured families. That part of the town at the foot of the bluffs along the water is known as "Natchez under the Hill," where the steamboats load cotton. The steep road leading up the high bluff brings us to a beautifully shaded, quiet town, with rich and cultured homes. Before the war this was a favorite residence of many important families, and now these old homes may be seen in the midst of abundant trees and blossoms. "In the suburbs, before the war, were great numbers of planters' residences—beautiful homes with colonnades and verandas, with rich drawing and dining rooms, furnished in heavy antique style, and gardens modelled after the finest in Europe. Many of these have been destroyed, but we visited some still preserved. The lawns and gardens are luxurious, the wealth of roses inconceivable. I remember no palace garden in Europe which impressed me so powerfully with the sense of richness and profusion of costly and delicate blooms as Brown's garden at Natchez. It was also on the bluffs at Natchez that the Indians in olden time kept the sacred fire ever burning, but which went out when the white men came."

Two other great rivers besides the Missouri come into the Mississippi from the west, the Arkansas above

Natchez and Vicksburg and the Red River below. The Arkansas comes all the way across the plains two thousand miles from the Rocky Mountains of Colorado. It is a fine river and is navigable to the Indian Territory. The Red River is also important for steamboat traffic. Formerly a great raft of driftwood, thirty miles long, obstructed the boating above Shreveport. But government engineers succeeded in breaking it up

FIG. 61.

Loading and unloading goods on the levee at New Orleans. Notice the mules, one of the most common draft animals of the South.

and in opening a passage for boats. At the time of spring floods these rivers also add their volume to the Mississippi and increase the danger of overflow.

New Orleans, the chief city of the Lower Mississippi, is built on a great bend in the river on lowlands sloping back from the high levees. The levee at New Orleans is crowded with steamboats loading cotton bales and barrels of sugar and unloading the cargoes from Europe and from the Atlantic coast. Fruits and tropi-

cal products are landed from the West Indies and South America. New Orleans was originally settled by the French and many French names and families are still met with. The great French market with its sheds and booths, fruits, flowers, and fish, is one of the peculiar attractions of this metropolis of the south. The cemetery is a beautiful park in which palm trees, bananas, magnolias, and other fine southern trees abound. The graves are marble vaults built above the surface, as the ground is so low and saturated with moisture that graves are not dug. At New Orleans was fought the famous battle at the close of the War of 1812 in which Andrew Jackson defeated the British.

The commerce of New Orleans and of the Lower Mississippi was hindered for many years by the bars of mud formed at the mouths of the river. An examination of a good map of the river below New Orleans will show clearly that the water of the Mississippi has carried down a great deal of mud and built up new land far out into the Gulf of Mexico. In forcing its way through the mud that has collected at its mouth the main current breaks up into three channels called the Southwest Pass, South Pass, and Pass à l'Outre. The flat, marshy land and water about these three mouths are known as the delta. "The river at the head of the passes finds its way to the Gulf of Mexico through these different channels. The Southwest Pass, the broadest and deepest of them all, trends to the right and Pass à l'Outre, the next in size, to the east, while between these two and more directly in the course of the river is the South Pass. The river just above its subdivision is a mile and three-quarters wide, forty feet deep, and carries every minute, when at flood, 72,000,000

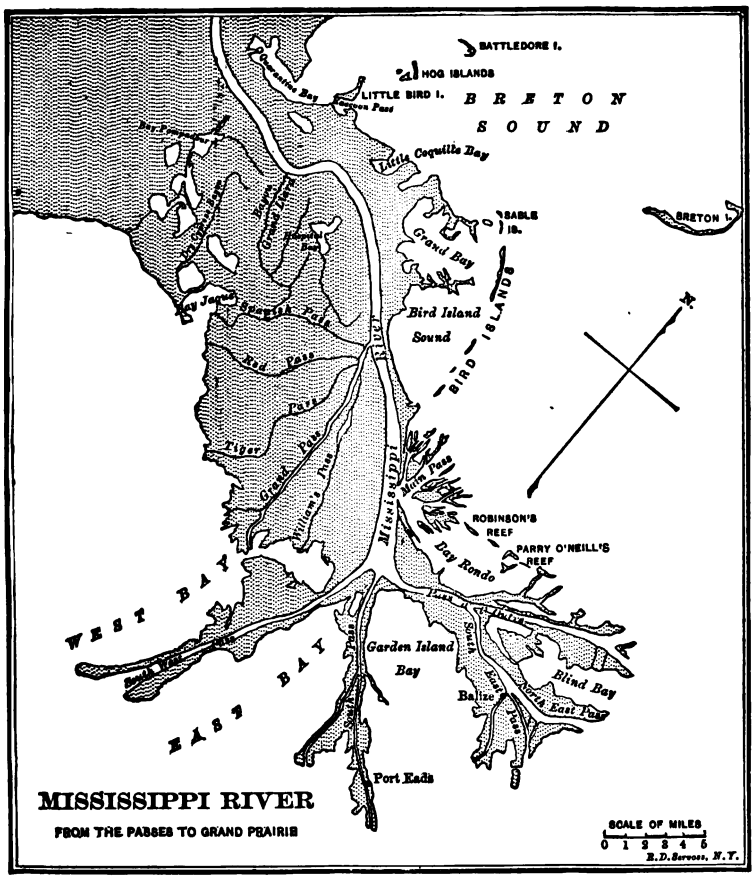


FIG. 62.

Delta of the Mississippi.

cubic feet of water to the Gulf. Every cubic foot of this vast volume of water contains nearly two cubic inches of sand and mud. Enough earth matter, it is estimated, is

annually thrown into the Gulf to build a prism one mile square and 268 feet thick. At the mouth of each pass is a bar, over which there is more or less depth of water." It is not a narrow ridge of mud, but a broad, flat bar of sand and mud four or five miles across. "At Southwest Pass the depth of water on the bar is about thirteen feet, at Pass à l'Outre it is ten feet, at South Pass, before the construction of the jetties, it was eight feet. The crests of these bars are not immediately at the end of the land, but from two and a half to five miles out in the gulf. Through the whole length of the passes there is a deep channel (uniform for each pass) about 1200 to 1500 feet wide in the two large passes and 600 feet wide in South Pass, and the depths are about 50 feet in the large passes and 35 feet in the South Pass."

As the water goes down through the passes it has a swift, boiling current and scours out a deep channel and carries its mud and sand with it. But when the rushing current reaches the broad, shallow expanse of water at the mouth, it spreads out and becomes sluggish so that the silt settles to the bottom. In this way these broad, flat bars are formed and kept constantly extending into the gulf. In the South Pass 100 feet per annum, in Southwest Pass over 300 feet per annum, were built up. These shallow bars at the mouths of the river were a great obstruction to ships going in and out. Dredging boats were used constantly to deepen the passage at Southwest Pass, at an expense to the government of $250,000 a year, but even then they could not secure a depth of more than eighteen feet and often less. All large vessels, therefore, were hindered from passing the bars.

"In 1859 a committee from the New Orleans Chamber

of Commerce visited the Southwest Pass, and found the bar blocked with a vessel while fifty-five other vessels were waiting to come in or go out. Some of these vessels had been there for weeks waiting for a chance to go to sea." Vessels of more than 700 tons burden could not pass the bars, but the average vessels of the Atlantic seaboard carried from 1200 to 1800 tons.

It was extremely important therefore to the commerce of New Orleans and the south to find some means of securing a deep channel to the gulf.

In 1874 Captain James B. Eads appeared before Congress at Washington with a plan for building jetties and deepening the current at the mouth of the river. He did not have the means for carrying on such an expensive undertaking, but he agreed, if Congress would furnish the money, to secure a channel thirty feet deep, and to receive no pay for his own labors till this result was accomplished. Many of the ablest engineers were directly opposed to Captain Eads's plan, but he explained his ideas so forcibly that Congress, in March, 1875, passed a bill authorizing him to make the attempt. Captain Eads desired much to make use of the Southwest Pass because of its greater depth and current, but he was compelled by Congress to make the attempt in South Pass.

His general plan was based on the idea of letting the river scour out its own channel, and even cut a deep passage through the bar beyond the mouth of the pass. Beginning at the upper end of South Pass, he began to build a line of jetties on each side of the channel, forming thus new banks, narrowing the current of water, compelling it to flow faster and scour deeper the channel of the pass. First a row of piles was driven down along each side of

the pass, but in the water at some distance from the shore. In some places the piles were driven in water thirty feet deep. It was found that these piles formed a firm and substantial barrier against which to build up the jetties. The piles were driven into the mud at the bottom of the channel by means of steam pile-drivers. This double row of piles extended in a curve along the sides of the channel of the South Pass and across the bar two and a half miles beyond to the open waters of the gulf.

The jetties themselves, which were built along these lines, consisted of great willow mattresses, from twenty-five to forty feet in width and a hundred feet long. "The jetties are constructed principally of willows. These trees grow in great abundance about twenty-five miles up the river, and vary in size from one to two and a half inches at the butt, and from fifteen to thirty feet in length."

The willow mattresses were constructed by Captain Eads on the following plan: "Along the bank of the pass were built inclined ways at right angles to the shore line and extending back from the river bank about fifty feet. The inclines are so constructed that while the ends of the timbers are under water at the river they are about six feet above the level of the water at the other or shore end. These timbers are spaced about six feet apart, and are parallel with each other. Boards below hold these timbers firmly in place. The ways are now ready for the mattresses, which are built in the following manner: Long strips of board, two and a half inches thick and six inches wide and from twenty-five to forty feet long, are laid across the slanting timbers, and spliced together until about a hundred feet high. If the mattress is to be forty t wide, nine strips are used and five feet apart. Holes

are bored in these strips one and one-eighth inches in diameter and five feet apart. Hickory pins whose ends have been turned to fit the holes tightly are driven into these, and wedged and nailed tightly. The pins stick up about thirty inches high. Some of the workmen now climb upon the willow barge and pass the willows down to the other workmen standing on the frame, who place the willows in a layer about six inches deep across the strips of the frame. Then a second layer of willows is placed at right angles to the first, and so on till the willows stand above the tops of the pins.

"In placing the willows the bushy tops project three or four feet beyond the frame. The men then bore holes in other strips about forty feet long, place them across the mattress, and insert the pins into the holes, pressing down the cross strips with levers. Wedges and pins are driven into the ends of the pins, and the mattress is done and ready for launching. The mattress is easily pulled off the ways by means of a steam tug, which tows it to its place along the jetty piling. A barge loaded with rock is then placed alongside the floating mattress, and the stone distributed evenly over it until it sinks to the bottom. The foundation mattress is usually from forty to fifty feet wide, according to the depth of the water. The courses above it become narrower and narrower until they reach the surface of the water, where the average width is twenty-five feet. When the mattresses are sunk into the river all the interstices fill very quickly with sediment, which serves not only to hold it more securely in place, but makes it much more impervious to water." A row of these mattress jetties was thus built on each side of the channel of South Pass, narrowing it to about 1000 feet.

"When the jetties were nearly constructed, it was decided to build temporary spurs or wing dams at right angles to the jetties, extending into the channel about 150 feet. These wing dams narrowed the channel from 1000 to about 700 feet. The objects in constructing these wing dams were: first, to locate the deep-water channel midway between the jetties; second, to hasten the channel development; third, to induce a deposit of sediment and an incipient bank formation along the channel side of the jetties. These wing dams were spaced about 600 feet apart. They were built by driving a row of piles out from the jetty line and resting the mattress against them, placing it on edge."

One of the greatest difficulties was to produce a deep channel through a large shoal at the head of South Pass. In order to produce a current into South Pass strong enough to scour out a channel through this shoal, dikes and dams were run up from the head of South Pass to raise the water and secure a more rapid fall. At first the result was to turn the water into the other passes, but great wing dams of mattresses were built across the channels of both larger passes which had the effect of raising the water in all the passes and in giving such a rapid flow through the shoal as to scour out a channel 40 feet deep.

From the very beginning of the jetty building, the effect could be seen in South Pass by a deepening of the channel. As the jetties progressed toward the bar, the channel across the bar gradually deepened from month to month. From May, 1875, to July, 1879, the work went steadily forward. At the end of this time there was a channel 30 feet deep from the deep water in the river to the deep water in the gulf. It was 700 feet wide at the surface and 200 feet

wide at the bottom. To form this channel through the bar required the removal of 5,500,000 cubic yards of material which has been washed out by the current into the gulf. Captain Eads also constructed a very large dredge-boat which was used to help deepen the channel in a few of the shallow places.

"At the outer end of the jetties, where they projected beyond the bar into the gulf, there was danger that the violent storms which beat against these shores at some seasons would destroy the works. To prevent this, a heavy line of stone and concrete was built out along the jetties.

"At distances of every 50 feet near the outer end of the work are built spur cribs, about 20 feet square, filled with rock, upon which a solid concrete block is built. Flanking the work at the extreme sea end are massive cribs of palmetto logs, filled with riprap and surmounted with larger rock."

The success of this great enterprise brought good not only to New Orleans but to the whole Mississippi Valley. It is estimated that the jetties, by partially improving the channel of the river, saved the country $1,600,000 during the year ending September 1, 1878, by the reduction in freights on cotton alone.

Before leaving the study of the Mississippi Valley, the whole river with its tributaries should be sketched, the different producing regions located, the chief marts pointed out and compared, the contrasts of climate and production noted, and the different kinds of populations and of occupations clearly perceived. This extensive valley, with its network of rivers and variety of producing regions, is a great, complex type of a river valley with which to compare other great river valleys of the world.

COTTON AND COTTON PLANTATIONS

Cotton was a native plant used by the Indians for making cloth in Mexico when Columbus first came. The sea-island cotton came from Honduras, and the cotton plant of the Southern States probably from Mexico.

The cotton crop of the United States is raised in the Southern States, Texas, Mississippi, and Georgia leading in its production. It is grown best in a warm and moderately moist climate. The summer season must be long and not subject to chilly temperatures. The great bulk of the cotton produced is of the white varieties which will grow anywhere throughout the southern sections of the United States; but the sea-island cotton thrives best only in the extreme southern belt, mainly on the islands and low coast lands of Georgia, the northern part of Florida, and the coast of South Carolina. It will grow higher up in the belt, but it does not mature well.

In many of the Southern States, cotton is the one great and important crop. The large plantations are most exclusively devoted to cotton raising. When a good crop is sold at fair prices it enables the planter to purchase all the necessaries and comforts of life, but if the crop fails the planter is brought almost to ruin. The growth of cotton raising in the South is remarkable.

A good description of a large cotton plantation in the South before the war would give us one of the most in-

teresting and characteristic pictures of southern life. The residence of the planter with its broad verandas stood in the midst of his extensive fields. The barns and gin-houses and the log huts or cottages of the negro laborers were near at hand. Hundreds of cotton pickers, men and women, under the control of overseers went into the fields, and often their plantation melodies were heard as they worked. But now the large plantation is frequently divided up into small farms and leased to small farmers. Each little farm has a cabin and stable where the man and his family live. They cultivate their farm for a money rental or in some cases for a share of the product. The owner of the plantation has a store on his estate where he keeps an account with each of his tenants, selling him tools and farm implements, feed for his team, seed for the planting, and other things. Sometimes a planter hires a number of hands to put in his crop and cultivate it as on northern farms.

Constant care is exercised to get the best seeds. These are obtained by watching closely the growing plants, the yield of cotton, and the quality of the fibre. Seeds are selected (1) as to fruitfulness of the plant; (2) as to the size of the bolls; (3) as to length of staple; (4) as to yield of *lint* cotton from a given quantity of seed cotton, and (5) as to shape of plant, *i.e.* whether it grows with long branches, thus requiring much room, or whether it has short branches or none at all. When the cotton is ginned in the fall the seed for planting is selected and set aside for the next crop.

In early spring the farmer begins to prepare the soil for the cotton crop. It is said jokingly sometimes that it takes "thirteen" months of the year to make a cotton crop. It

does take about all the year in one way or another to succeed with a cotton crop. The first work in preparing the soil is to break the land thoroughly by deep ploughing. Soon after this the "beds" for cotton rows are made. To do this furrows are run with ploughs. In rich lands these furrows for the rows should be from four to five feet apart and in moderate lands from three to four feet apart. In these furrows is placed whatever manure or fertilizer is to be used on the crop. (In thin lands this fertilizer, under favorable conditions, increases the yield of cotton, and even in very rich lands it aids, as the fertilizer brings the plant to maturity earlier and it thus escapes the frost.)

To make the "beds," a furrow is first run on each side of the furrow containing the fertilizer and afterwards in the same way the land between the rows is thrown toward the original furrows, until there is only one furrow, which is called the middle furrow. When the land is all ploughed in this way, it is said to be "bedded" and it consists of a series of long, flat surfaces divided by furrows which are the width of the rows apart. The land then stands in this condition until it is thought that the weather is warm enough to plant the seed.

In the old way of planting, a man with a horse and plough opened the bed by running a small furrow on top of it just over the furrow in which the fertilizer was placed, and another man sowed in this furrow the cotton seed which he carried in a bag or basket; behind him went a man with a horse and plough or harrow with which he covered the seed.

This planting is now done by the use of a cotton planter which is a modified plough. It has (1) a small plough which opens the bed, (2) a box containing the seeds which

are distributed in the furrow by means of a wheel which runs on the ground, and (3) a double plough or two small ploughs that cover the seed. In this way one hand, a horse, and plough can do as much work as three hands, two horses, and two ploughs did in the "old way."

When the ground is warm and moist enough the seeds will germinate in about ten days. Usually there are more plants than are needed. In about ten days after the plants are up, the ground is lightly ploughed and harrowed to clear away the young grass and weeds around the plants. After the plough come the hands with weeding hoes with which they cut out the surplus plants and the weeds, and grass in the rows. The plants should be left ten inches to twenty inches apart according to soil. The plants grow quite rapidly in good seasons and they must be ploughed or hoed every fifteen to twenty days to keep down the grass and to stimulate the growth of the cotton. Light ploughing or harrowing is best as a rule. When the plant has begun to fruit fairly well, ploughing should cease, unless it be of the very lightest character.

When the plants are about six or eight weeks old the "squares" begin to appear on little stems growing out of the main stalk. These "squares" are hollow, triangular-shaped pyramids, which contain the young bud which is to produce the bloom. In a few weeks more the bloom appears. It is large and creamy white the first day. It is of striking appearance, among the green foliage of the plant. A field in which there is a large percentage of white blossoms makes a beautiful scene. On the second day the bloom is pinkish to red in appearance, and the third day it drops off, and at its base may be seen the young boll. This boll is in the shape of a prolate

spheroid which is sharper and more gently tapering towards its apex than towards its base. It is divided into four or five elongated cells, which are separated by longitudinal partitions of tough fibre. Each of these cells contains a "lock" of cotton, *i.e.* a number of seeds surrounded by cotton fibre.

This boll soon grows to maturity, when it turns brown, or is streaked with brown or red spots. As it dries, the pod or boll cracks open longitudinally along four or five seams, and the cotton fibre is exposed to view. In two or three days it is dry enough to be picked. While this boll has been maturing, the plant has been growing rapidly, blooms have been appearing, and young bolls have been forming, so that you may see all the stages of fruiting on a single stalk from the young "square," which can be scarcely detected by the naked eye, to open bolls with fibre ready to be picked. The plant, with good seasons, makes fruit till frost stops its growth. The number of bolls on a single plant depends upon the season, the cultivation, the soil, the variety of cotton, and other conditions. You will thus see that many things affect the cotton crop. Some stalks mature 150 to 200 or more bolls, though the average is much less than this. It is said that, with a reasonable stand of plants, an acre that will average ten bolls to the stalk will produce a bale of lint cotton. This is above the average. The plant is subject to diseases, as rust, and it is attacked by bugs and worms, which sometimes destroy the crop.

There are three kinds of worms that often destroy the cotton plants; the cutworm eats off the young sprout down to the root, the boll-worm gets into the cotton boll and destroys the cotton, and the army-worm comes in August and strips the plant of leaves and cotton bolls.

The cotton boll weevil also, in the last ten years, has been doing increasing damage to the cotton fields of Texas. After spreading north and east from Mexico across Texas, it has entered Louisiana, and now threatens to overrun all the cotton-growing states. This weevil punctures the cotton boll with its beak and lays its eggs in the puncture, where the grubs develop and destroy the cotton. During the last few years this little insect is estimated to have destroyed $10,000,000 worth of cotton each year in Texas, besides the loss to shippers and manufacturers. Several of the state legislatures have appropriated large sums of money to fight the spread of this evil, and Congress at Washington has lately appropriated several hundred thousand dollars to find means of stopping its ravages.

Too much rain will cause to be produced a large plant with little or no fruit. If there comes a dry spell, and the plant has managed to live through it, seemingly very well, and rains suddenly set in, the plant puts on new life. In this case it sheds off all young squares, and even young bolls, and quits blooming. It goes to work, making more stalk and new forms. This is called the second crop. If there is time for it to mature, the crop may be very good. If the frost catches this crop the yield is poor. These conditions all vary with the time that the drought strikes the crop and the time of frost.

Cotton picking begins as soon as enough bolls have opened to justify going over the field to gather them. In the lower part of the cotton belt this may begin about the middle of July ; in the upper portions about September 1. The seasons cause these times to vary much. In 1902, the first bale marketed was about July 20th ; in 1903, on August 1. (In 1902, the price paid for the first bale was

11 cents per pound; in 1903, 15½ cents per pound. In both cases the bales were raised and sold by a farmer in south Georgia.)

The cotton is picked by hand; no machine has yet been invented that can do this work as satisfactorily as it can be done by the human hand. Negro labor is employed very largely in the production of cotton, especially on the large plantations. Many of the smaller farmers have enough hands to gather their crops, but where the lands are rich and the seasons are favorable a laborer can cultivate more cotton than he can gather. Then extra hands must be employed, and they are paid so much a hundred pounds for picking, sometimes 50 to 75 cents, or more. When the cotton has just opened and the seeds are not quite dried, a nimble hand can pick 200, 300, and sometimes even 400 pounds a day. The picking of 200 pounds each day, however, is a task which few can do. The average amount would not exceed possibly from 100 to 125 pounds a day.

On small farms near the settlements the hands are provided with baskets and sacks made of some coarse cloth. The hand places his basket at some convenient point and picks the cotton, placing it in his sack, strapped to him. When the sack is full he empties it in the basket. He continues this until the basket is full. It is then carried to the cotton-house and weighed, and an account is kept with each hand to see what he is doing, and, if he is paid by the quantity picked, to determine his pay for the day. By keeping an account of weight, the farmer can also know about how much cotton he has ready for ginning at any time. This picking goes on till the crop is gathered. Sometimes a field is picked over many times. In this way

FIG. 63.
Picking cotton.

FIG. 64.
Cotton ready to be shipped.

we get the best cotton. Sometimes the field is picked only once, and that late in the fall, sometimes in the winter. In this case poor cotton is obtained, it having been injured by the weather. The cotton gets stained sometimes with rust, and also by the leaves of the plant when they are frost-bitten and still moist.

The loads of sacks are carried to the gin-house or place where the cotton fibres are separated from the seeds. Before the invention of the cotton-gin it kept one person busy a day to separate a pound of cotton from the seed. But after the invention of the cotton-gin three hundred pounds could be separated in a single day by a single machine. The story of Whitney's difficulties and successful invention will be found in a good cyclopædia or history. The gin itself has a revolving cylinder with nine-inch saws half an inch apart; each saw passes between parallel wires seizing the threads or fibres of cotton and pulling them through, but leaving the seeds; quickly revolving brushes sweep the cotton from the teeth of the saws and a blast of air drives the cotton to a condenser and cleanses it from dust. The cotton room of the gin-house is an interesting place with its great piles of beautiful snow-white cotton.

Before shipping, the cotton is piled into a heavy press, wrapped in a stout bagging, tightly pressed, and narrow strips of iron are clasped round the bale and fastened. This is the press-room, and the workmen are grotesquely covered with cotton, as in the gin-house. The cotton bales, weighing five or six hundred pounds, are hauled to the railroad station, or to the steamboat landing, where the stops are regularly made by the steamboats to take off the cotton. It is then carried to New Orleans or Memphis,

whence it is shipped by water or by railroad to the great factories where it is made into cloth of various kinds.

The cotton-seeds were formerly of no use, but now they are put into presses where the oil is squeezed out, and, when purified, it is much used in soap making and as a substitute for olive oil. The cotton-seed cake, which is left after the oil is pressed out, is also used as fodder for cattle, and the cotton-seed meal as a fertilizer. The

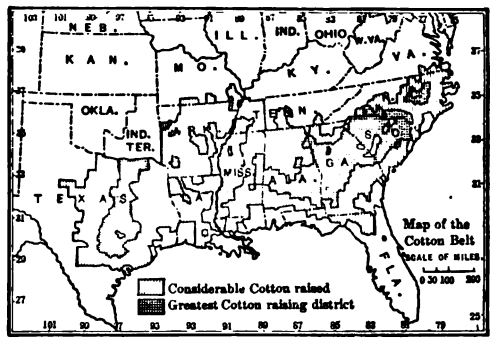


FIG. 65.

value of the various cotton-seed products taken together amounts to millions of dollars every year.

There are large cotton-manufacturing cities in New England, such as Fall River and Lowell. Much of the raw cotton is shipped to Boston and New York, whence it is sent to the mills. More than half of all the cotton is exported to England and Europe to be used in their factories and then sent out over the world. In recent years large factories have been established in southern cities, as at Richmond, Atlanta, Columbia, Greenville, Augusta, Columbus, and a number of other places, where the cotton can be manufactured into cloth without shipping.

The cotton belt stretches from North Carolina to Texas, and from Kentucky to the Gulf. The climate is hot and negroes perform most of the field work. The planters engaged in the cotton production often depend upon the sale of cotton for everything with which to carry on the work of the plantation. They scarcely raise the corn and vegetables necessary for plantation use. When the price of cotton is low, or when a bad crop comes, many of the planters often have to run in debt or even to sell their farms.

The chief cities where cotton is collected and shipped are Galveston, New Orleans, Memphis, Charleston, Savannah, Norfolk, and New York. The railroads have now become of very great importance in moving the immense cotton crops of the South.

Immediately after the war the cotton-planters had great difficulty in making the business pay. Wages were high, and many rich lands in Texas and Arkansas were planted in cotton, so that there was over-production of cotton and low prices. The cotton-planters have been urged to raise other crops, as corn, vegetables, grain, and fruit, and to feed hogs and cattle for their own meat supply; but they have been slow to adopt a variety of crops and have depended chiefly upon cotton. Many of the old cotton plantations have lost their productiveness because there was no proper rotation of crops.

On the whole, cotton raising is very profitable and is the chief source of wealth in the South. The cultivation of this staple in that section began about the middle of the seventeenth century, and coarse clothing was early made out of the fibre. Before Whitney's invention of the cotton gin in 1793, however, the amount of cotton

grown in the Southern States was comparatively insignificant. In 1820 the entire crop of the United States was 455,000 bales, and in 1898 it was 11,000,000 bales. About 68 per cent of this was shipped to England and other foreign countries. The United States raises about two-thirds of the cotton crop of the whole world.

SUGAR PRODUCTION

THE sugar used on our breakfast table may come from several widely separated sources, from Louisiana, Cuba, or Germany. Formerly our sugar was obtained only from the warm, semi-tropical regions, where the sugar-cane flourishes, as in the lowlands of Louisiana or the West Indies. But in recent years much of it comes from the beet-sugar farms of Europe or of our Northern States.

FIG. 66.

A sugar-cane field in Louisiana, with the sugar houses in the background.

A large sugar plantation in Louisiana illustrates the older and simpler way of producing sugar. Such a plantation may have several thousand acres planted in sugar-cane. Near the residence of the planter are the sugar-mills, with the engines, vats, and machinery, for working up the cane into raw sugar, the sugar house, and also the buildings for the laborers.

The sugar-cane is best raised in a warm climate, where frost seldom comes, and on a rich soil, usually in lowlands.

Sugar-cane is planted by laying the long stalks in a furrow in rows five or six feet apart and covering them. These stalks are planted during the summer and the sprouts do not gain their full growth till the second year. The fields are well cultivated in a rich, moist soil. The canes grow to a height of eight to sixteen feet and are from one to two inches in diameter. When full grown the stalk and pith are saturated with a rich, sweet juice, from which sugar is made.

The ripe stalks are cut off close to the ground, stripped of their leaves, and loaded upon carts or cars, to be drawn to the sugar-mill. The roots of the old stalks are covered with crushed stalks that have been through the mill and by fertilizers. New shoots spring up and grow to full-sized stalks, which are later harvested. This process of sprouting or *rattooning* may be continued for several years, but the product from *rattooning* gradually declines, and the field after a few years must be replanted.

The sugar-mill, run by a steam-engine, consists of heavy, close-set parallel rollers (something like a clothes-wringer) between which the stalks are passed and crushed. Sometimes the crushing power is increased by hydraulic pressure. The more juice squeezed out, the greater is the amount of sugar obtained and the dryer the fuel. The crushed stalks are then used as fuel for the engines.

The juice squeezed from the stalks is collected in a trough and then carried by pipes and dropped, through fine screens for removing impurities, into clarifiers, which are large basins or iron tanks, each holding six or eight hundred gallons of juice. Heat is then turned on till the juice reaches a temperature of 130 degrees Fahrenheit, milk of lime is added to the juice, and the whole heated to the boiling-point. A thick scum forms on top which

contains many of the impurities in the syrup. The clear juice is then drawn off and run into a series of five pans, where it is gradually boiled down, the syrup becoming thicker as it passes from pan to pan, till in the last it is ready to crystallize. In a second series of shallow pans, into which it is poured, it is then allowed to crystallize into sugar and is transferred to hogsheads placed in the curing-house, where the molasses is drained off. This gives the brown sugar sent to the refineries, where it passes through a series of processes, the result of which is the white refined sugar of our tables.

The above general process, thus briefly described, is the old method of sugar making still common on many plantations and in the West Indies. Several important improvements upon this method have been made, requiring expensive machinery and more scientific knowledge. First is the process of *diffusion* by which the canes are sliced, soaked, and squeezed, and a much greater percentage of sugar obtained. Second is the use of the vacuum pan by which the syrup is boiled at a low temperature. Third is the centrifugal separator by which the sugar is drained of its syrup.

The raw sugar produced on the plantations is shipped to New Orleans or to northern cities, where there are great sugar-refineries or factories devoted to the purifying of raw sugar and syrup, and where the white sugar of commerce in its various forms is the result.

In these refineries a complex scientific process of treating the crude sugar is worked out, which can only be briefly indicated. The sugar is again brought to a liquid form, is filtered through twilled cotton bags, and then passed through deep layers of animal charcoal to remove color. In

vacuum pans the sugar is again crystallized and the syrup carried off either by filtration or by centrifugal action.

Improved machinery has been introduced upon some of the plantations of Louisiana and scientific methods are used by which a greater percentage of sugar is obtained at as low cost as possible.

In addition to the cane-sugar produced in Louisiana and in the gulf states, we receive a large amount of such sugar from Cuba and the West Indies. The processes of sugar production in Cuba are simple, old-fashioned ones and are wasteful.

As a result of the recent Spanish War, Cuba has been brought into closer political relation with the United States. The chief difficulty in establishing proper commercial relations with Cuba was found in fixing the tariff on sugar, as the sugar producers in the United States were not willing to admit Cuban sugar free of duty.

We also receive much cane-sugar from the Hawaiian and Philippine islands, where the climatic and soil conditions are similar to those of Cuba. Notice on a map of the world the latitude of Cuba, Louisiana, Hawaii, and the Philippines. It will be observed that cane-sugar production occupies a belt in the semi-tropical regions, extending perhaps round the world.

In recent years beet sugar has gained great importance for the United States. First, because a large part of the sugar consumed in this country is beet sugar brought from Germany and costing us many millions of dollars; and second, because in several states sugar beets have been successfully raised and large sugar-beet factories started. From the experience of France, Germany, and Austria, there seems to be no reason why the United States, with its

rich and varied soil, may not produce as much beet sugar at least as it wishes to consume. The people of the United States consume more sugar per capita than the people of any other country, and it will be a great economy and in fact a large source of wealth if we can produce our own sugar.

In the last few years sugar-beet factories have been established in California, Colorado, Illinois, Michigan, and

FIG. 67.
Spreckels's beet-sugar factory, Salinas Valley, California.

other states, and large areas of adjacent farm lands have been given to the raising of sugar beets.

For the raising of sugar beets a rich soil is required, and the effort of the farmer is to produce as large a tonnage of beets per acre and as rich a percentage of sugar in the beets as possible. It takes about five months to raise a good crop of beets. The seed is planted in rows about eighteen inches apart and very carefully cultivated. The expense of repeated ploughing, hoeing, thinning, and

harvesting is great, but the tonnage is heavy and with good yield the profits are large.

In Germany a strong effort has been made by a careful selection of seed to procure the largest percentage of sugar. The result of these scientific experiments and this care in selection is that the beets now raised in Germany produce about double the amount of sugar per hundred pounds that they did fifty years ago. It is a good illustration of the value of scientific farming.

In the year 1800 when Napoleon was at war with England he found his ports blockaded by English ships and France's supply of sugar cut off. He offered a prize of one hundred thousand francs to any one who would devise a profitable method of extracting sugar from beets. The French chemists undertook the work, and later the German chemists carried the experiments forward; but it was not till about 1840 or later that commercial sugar was produced. Both the French and German governments gave a bounty on home sugar, and thus a great industry was gradually developed which produced hundreds of millions of dollars' worth of sugar.

In the fall the beets are dug, topped, and hauled or shipped to the factory. The process of extracting the pure sugar from beets is much more difficult than from cane.

When the beets are first brought to the factory they are trimmed and washed and then thrown into a great hopper where they drop upon a series of knives which slice them into fine chips, almost a pulp. This pulp is then thrown into a series of upright tanks or cylinders which are closed tight. Twelve of these cylinders form a complete series and each holds two or three tons of sliced beets. After steaming the beets to soften them, water is

let into the first cylinder and soaks the sliced beets, thus drawing out the sugar into the water. This is called the process of diffusion. This sweetened water is then forced into the second cylinder where a further process of diffusion takes place and so on to the eighth, where the water has become loaded with the sweet juices and is drawn off. The first cylinder is then disconnected and a ninth cylinder with fresh pulp is connected with the eighth and the water from the eighth passes on to it. The pulp of the first cylinder is removed and its juices squeezed out. Thus four cylinders are free at any time for removing old pulp and receiving new.

The water saturated with sugar is now boiled down in a manner similar to that described in the case of cane-sugar and finally crystallized into brown sugar. The impurities in beet sugar are greater in quantity and much more difficult to separate from the sugar than in the case of the cane. The process of refining raw sugar is about the same in the two kinds.

A study of the map of those parts of the United States and of Europe where beet sugar is produced will reveal the fact that the beet-sugar production lies in a belt in the temperate zone, parallel to the cane-sugar belt, but much farther north.

A third kind of sugar much produced in the United States is the maple sugar obtained from the hard or sugar maple tree. The old-fashioned sugar-camp, with its trees tapped and running sugar water from the spouts inserted in the holes bored into the tree is a favorite picture with people of the hard-wood forest region. The sugar water collected from pails or wooden troughs is boiled down in great kettles till it sugars off. The maple

sugar does not require a process of refining, as the peculiar flavor given it by the maple tree is its most desirable quality and gives it a higher value in the market. The sugar-producing forests are in Vermont, New York, Ohio, Michigan, and other states where the hard-wood forests prevail. In Vermont and other northern states where sugar camps abound more elaborate methods are employed. Sugar-houses with tanks and evaporating machin-

FIG. 68.

Old way of boiling the maple sap in the forest to make maple sugar. In many sections this is an important industry in the spring.

ery, pans, etc., are provided. Loaf-sugar and canned maple syrup are put up in considerable quantities for the market.

A comparison of the three kinds of sugar and their modes of production will bring out the fact that they are all derived from vegetable growths by extracting the sweet juices containing the sugar. The process of obtaining the juices varies, but the boiling down and crystallization of the sugar in all cases is the same. The process of

refining and careful purification is common to the cane-sugar and beet sugar of commerce.

The production of beet sugar is interesting because it is based entirely upon careful scientific experiment, and the invention and use of complex machinery. It is only highly civilized nations that are capable of working out such difficult problems and creating great industries based upon pure scientific knowledge.

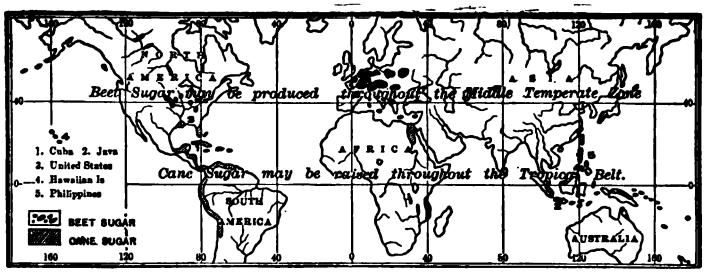


FIG. 69.

Distribution of sugar-cane and beet sugar.

In connection with this topic a study of the map of North America and of the world for the purpose of locating the three sugar-producing belts is very appropriate.

This topic like some others is a good type of the three stages in the systematic and natural treatment of a subject: (1) Agriculture; the beet farm or the sugar plantation; (2) the process of manufacture, including the cruder forms of manufacturing on the plantation, the sugar factory, the refinery, and the cities which are the centres of sugar-refining; and (3) the commercial routes by which sugar is brought to market, and the chief shipping points and centres of the sugar industry.

A CATTLE RANCH

On the cattle ranches of the western plains are found the rough-riders and bronco-tamers, whose free life on horseback is so attractive to the boys. The raising of cattle on these ranches is the main business over large stretches of country. The Great Plains that lie just east

Fig. 71.

Cattle feeding on the Great Plains, where the herds of bison formerly roamed.

of the Rocky Mountains from Canada to Texas are chiefly valuable for cattle raising, and it is here and among the foot-hills that the cowboys are at home.

Such a cattle ranch as we are describing lies in a creek bottom where there are grassy meadows, and a pasture is fenced in for the grazing of the horses. There are scattered groves of cottonwood along the stream, and near one of these groves is a large log house for the owner of the herd and ranch. Close by is a long, low house, with kitchen and rooms for the cowboys. A blacksmith shop

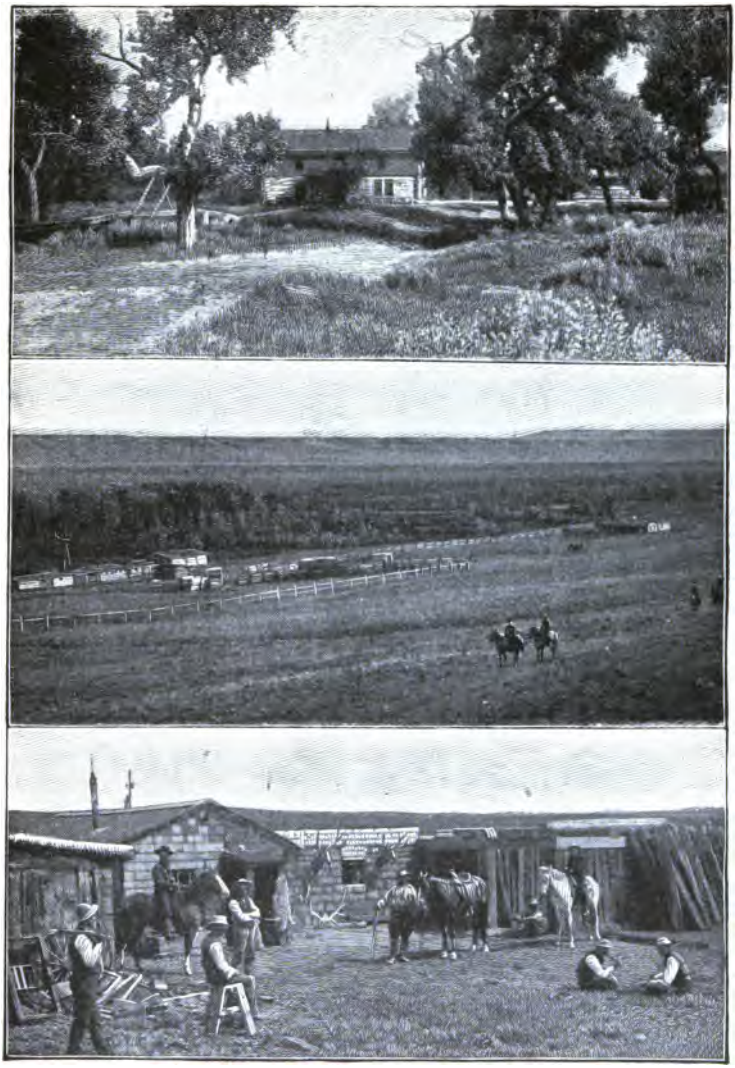


FIG. 70.

Scene in the ranch country. Upper picture, a typical ranch house on the banks of a stream in western North Dakota. Middle picture, a ranch house and "the range." Lower picture, a group of cowboys at the ranch house.

stands on one side of the enclosed lot, and barns and cattle sheds are placed on the other two sides. A few stacks of hay mowed from the bottom-land are seen near the cow sheds. A tall windmill stands by the barn with large troughs below for the water pumped by the wind.

Low hills line the two sides of the valley, and beyond these hills the level and rolling plains stretch away for miles without sign of tree or even grass; for the short, thin grass that grows upon these dry plains cures on the ground during the summer, and the whole wide stretch of plain looks like a lifeless desert.

FIG. 72.

A cowboy with his rope, or *lariat*, with which he captures the steers by throwing a noose over their necks, or around their legs.

Some men come out of the low stable in which the ponies are feeding. Their broad-brimmed hats and fringed leather leggings, together with the rough spurs hanging to their heels, soon convince us that we are among the cowboys. They are small, hardy-looking men, thoroughly browned and hardened by exposure. A saddled pony is brought out with a rope hanging to the saddle-bow, and a cowboy mounts and gallops across the bottom to the hills and range beyond to bring in a drove of cows.

A large number of ponies are seen grazing in a field fenced with barbed wire.

The owner of this ranch has a herd of three thousand cattle, which run at will upon the plains of the surrounding region. There are no fences to separate this ranch from its neighbors on the several sides, so that the cattle mix freely with those of other ranches for a hundred miles or more. All these lands belong to the government of the United States, which allows the cattle owners to graze their herds freely upon the range. Only along the valleys of the stream where there are meadow-lands that can be farmed or irrigated is the land taken up for homesteading. The cattle owner buys up such farms and then allows his cattle to range on the neighboring plains.

During the summer time there is little rain in this region, but in the early spring showers start the grass to a quick growth, and as soon as the hot weather of summer sets in the thin grass begins to dry and cure on the ground, and supplies a nourishing food for cattle during the fall and winter. In the winter time snow often covers the ground, but if not too deep it soon melts away and leaves the grass exposed again. The cattle are expected to get their own living both in summer and winter from the scanty grass on the plains. In the winter, also, instead of water they eat the snow, and are thus able to graze farther away from the streams than in summer. In the long, sunny days of summer time the streams are often dry or nearly so, but wells have been bored at suitable camps and ranch-stations, where water can be pumped by windmills and supplied to the herds.

All kinds of supplies for the lonely ranch are brought by wagons from a town 150 miles away at one of the railway stations. The canvas-covered wagons, loaded with food, clothing, tools, and weapons, saddles and equip-

ment, are hauled to the ranch by mules or yokes of oxen.

The owner of the ranch was an eastern man who came west with several thousand dollars to make his fortune in the cattle business. Buying a small herd of two hundred cattle at first, he steadily increased his herd from year to year, taking good care of the young calves, and only selling off the steers which were old enough to send to market. By constant watchfulness over his herd in all seasons, and by buying up more cattle with the profits from sales, he has gradually collected a large and valuable body of animals. He has had, also, the trouble and expense of securing good cowboys and ponies for his ranch, together with the usual running expenses for board, housekeeping, stables, and other incidentals. He also runs the risk every year of great losses, from storms which freeze the cattle, or from diseases which destroy, or from cattle thieves. The owner or manager of a cattle ranch, therefore, must thoroughly understand all the difficulties of his business, and be constantly on the watch.

His chief helpers are cowboys, who receive as wages from $25 to $40 a month besides their board and keep. The cowboys are usually trained to their work from boyhood. Living almost constantly on horseback, except when asleep, they become the most expert horsemen. Some of them are wonderfully skilful in riding and mastering the wildest and wickedest horses. But most of all, they must have skill in using the rope or lariat which hangs from the saddle-bow. This rope is the most useful instrument in the hands of the cowboy. By long practice he can swing it around a steer's horns or hind feet and quickly bring him to the ground. In handling

the cattle in the corral or in the plains, this use of the rope is all-important.

As the cattle scatter out over the plains, it is the business of the cowboys to keep track of them as far as possible, to go to neighboring ranches for stray cattle, look after the cows and calves, see that water is supplied, and in winter shelter them, if possible, from storms. The cowboy must be out in all sorts of weather, exposed to cold and storm and hunger, and must be able to find his way over a wild and desert region in all sorts of weather, day and night.

FIG. 73.

A scene during a round-up, when great numbers of cattle are bunched together.

Twice each year it is the special labor of the cowboys to round up the herds over a large region of country. The cattle from many ranches having become mixed on the plains, the stockmen with their cowboys combine to collect them. The captain or general manager of the round-up, at an appointed time and place, meets all the foremen or ranch owners and cowboys from the different ranches. A wagon from one of the ranches carries bedding, food, and a mess kit for a dozen or more cowboys, and each cowboy brings to the round-up eight or ten tough, experienced little ponies.

The captain of the round-up divides up his men into at least three large groups, one group scattering out fifteen or twenty miles on the left, the other on the right, the third in the centre, drawing together toward the central line of march all the cattle in a strip of country thirty or forty miles wide. Starting out before sun-up, by noon they are able to bring the different herds together, at one large rendezvous. The afternoon is spent in "working" the herd already collected. Cowboys from the different ranches ride in among the cattle, and by the brands pick out their own cattle and, "cutting them out" from the main herd, bring them together. Later the young calves and unbranded cattle are corralled, and the branding irons are used to stamp them with the owner's mark. Each calf has to be caught with the rope, thrown, and held down, while the branding instrument is applied. At night each herd is closely bunched together and guarded, and early the next morning the two flanking divisions of cowboys are sent out again to gather in more cattle, while the herds previously gathered move on to the next rendezvous. The cowboys are on their ponies twelve or sixteen hours a day, much of the time moving with speed. After perhaps six weeks of continuous labor the whole territory has been worked over and the cattle brought together, divided up, branded, and returned to their separate ranches.

A cowboy needs several ponies on the round-up. A pony is not used more than one day in four, resting and feeding between times, as the travel over the rough range country is swift and hard.

Sometimes the nights are cold and stormy, and the men bunking under the wagons are drenched with rain. On such a night the cattle in the herd may become restless

and break away from the guards, scattering over the plains, and causing endless trouble in collecting them again.

During the whole six weeks or more of the round-up, the cowboys are employed from twelve to sixteen hours a day at the roughest and most exhausting work; but in spite of this, it is probably the most enjoyable part of the cowboy's life. There is no end of fun and banter and rivalry among the men from different ranches. While in camp, the skilful riders tame the worst bucking ponies, and there are plenty of horse-races and foot-races, shooting matches and other sports. For months the boys have been accustomed only to the lonely life of the ranch, and this season of round-up where a hundred or more cowboys meet and work and camp together, is full of excitement and interest.

These great round-ups take place at least twice a year — in the fall and spring. In the spring round-up the cattle are collected after the winter storms and losses, the calves are branded, and the herd brought to the home ranch, where they are again turned upon the nearer range. In the fall round-up the well-matured beef cattle are selected and prepared for shipment to Omaha or Kansas City. First they are driven to the nearest railroad station, and there loaded on trains for those great centres of the cattle trade.

All cattle are branded before they are turned upon the range. For this purpose the herd is got together in the corral or pen, and the cowboy rides in with his rope and brings the steer or cow to the ground, the horse being almost as skilful as his rider in throwing the cattle. Then a red-hot iron brand is applied to the shoulder, hip, or side of the animal, burning the sign or figure into the hide.

These brands are all registered by the stockmen, and no two ranches or stockmen are allowed to use the same sign or mark.

The cowboys are also skilful in the use of firearms, and usually go well armed. They are, for the most part, quiet and orderly, except when they sometimes collect in towns, where they are apt to visit the saloons and horse-races and get into street brawls. Men are often killed in these encounters, and there is often seen in the border towns visited by cowboys all the roughness of frontier life. But they are as a class honest and skilful in their work, entirely devoted to the interests of their employer, and to strangers friendly and hospitable.

FIG. 74.

Picture showing the mother with her brand, a calf following her, and a cowboy about to catch the calf and brand it.

The ranchmen and cowboys have had much trouble with horse thieves and cattle thieves. The rough frontier is the natural place for criminals and bad men to collect. When the buffalo were still abundant on the plains, these men found amusement in killing buffalo; but when the buffalo were all gone, they must either turn to some honest business or become thieves, preying upon the cattlemen. The cattlemen banded together to put an end to horse stealing and cattle thieving and killing. The thieves formed bands, which collected at some hut or hiding-place in the foot-hills, where they were pursued and hunted out

by the cattlemen. Battles were sometimes fought, and many men were killed in these conflicts between the cowboys and the thieves. When once caught, the thieves were hanged, and the western country has now been well freed from such criminals.

The cattle business in the northwest, in Montana, Wyoming, and the Dakotas, suffers greatly from occasional severe winters. Even in Kansas and Colorado the winter blizzards have done great damage. The cattle of the plains were not protected with barns and sheds or comfortable strawstacks, as in the farming states farther east. When such a freezing blizzard from the northwest strikes in, the cattle can only huddle together and turn their tails to the pitiless storm. A herd is often driven for miles before the face of such a storm. If they come to some impassable stream or deep railroad cut, they huddle together till frozen in their tracks. The skeletons of dead animals are found thick piled in such a place. In the spring of 1872, at the close of a hard winter, the herds of western Kansas had lost about half their cattle in the severe winter storms. In the spring of 1881 the plains at the edge of the foot-hills in Colorado were strewn with the carcasses or bones of animals that had starved or frozen in the fierce storms of the preceding winter.

When the snow falls deep upon the plains, it completely covers the feed, and unless it soon melts away, the cattle starve. Cold, sleety rains, which soak the hides of the cattle and cover the plains with a sheet of ice, are very severe. The bodies of the cattle become coated with the chilling ice and the grass is changed into icicles, so that the cattle both freeze and starve.

In preparation for such weather it is the work of the cowboys to drive the herds into sheltered valleys behind the hills and to find a range where the grass is still abundant. When cattle have been frozen upon the plains, their hides are still valuable, and the men are kept busy searching out the carcasses and getting the skins. The losses of the ranch owners during such severe winters are very discouraging, and men often give up the business. It is also a great pity and inhumanity to expose animals to cold and starvation in this wholesale way. Many men are too considerate and kind-hearted to engage in a business which involves such cruelty and suffering.

Along the river valleys, where the meadows can be irrigated and a good store of hay secured, it is possible in many places to put up stacks of hay which can be used to help feed the cattle through the severe winter storms. In this way small herds can be well taken care of through the winter. Cows with young calves suffer most with winter cold and storm. Therefore they are kept mostly upon the warmer plains of Texas, while thousands of steers, bred on these southern plains, have been driven north to spend the fall on the grassy plains of Wyoming and Montana. In the same way other thousands of young steers from the farm lands of Kansas and Nebraska have been driven west a few hundred miles to feed on the ranges.

In recent years the great danger of the cattle business in the northwest has been the overstocking of the range; that is, the collection and increase of cattle on the ranches till there is not sufficient grass to feed them and supply grazing. When grazing lands have been too closely

cropped, the grass dies out, and the land becomes almost worthless for range. The cattlemen themselves have been compelled to combine and limit the number of cattle turned loose upon the plains. A single cow or steer requires from fifteen to twenty-five acres of land to supply sufficient grass. In the rich farmlands of Iowa one or two acres would supply enough food for an animal. This shows how sparse and thin the western grass is.

The western part of Texas is most favorably situated for the cattle business, and here are found the greatest cattle ranches. Wealthy men have bought up or leased from the state of Texas large areas of country, which they surround with wire fences and use for cattle ranges.

In the *Review of Reviews* for September, 1901, Mr. Barker says: "Texas is noted for the number and extent of its ranches. Of a total of several thousand [ranches], they vary in size from a few thousand to several million acres, the large ones averaging 50,000 acres. The greatest is the 'X. I. T.,' in the Panhandle, which embraces half a dozen counties and contains nearly 3,000,000 acres. It belongs to the 'Capitol Syndicate,' a company of men who received this vast territory some twenty years ago in return for providing the magnificent state house at Austin. The ranch is divided into seven divisions, each managed by a foreman, and each connected with the headquarters by means of telephones. The whole is run with the system and despatch which characterize all great industries. On this ranch now run considerably over 100,000 head of cattle, and an idea of its size may be gained from the fact that the pasture fence extends 210 miles in one direction and 25 in another, making a total area of about 5000 square miles. From time to time

small parcels of land have been sold, and, meanwhile, valuations have appreciated from fifty cents an acre to four times that amount."

The larger ranches usually have about 50,000 acres each, and are managed by a foreman, who has a good house. There are almost no trees or fuel on the western plains of Texas, and provisions and all the necessaries of the ranch must be hauled hundreds of miles in wagons.

The whole range belonging to the ranch is fenced in, so that the cattle do not wander at will and mix with other herds, and not so many cowboys are needed for the care of the stock. The headquarters of one of these large ranches is completely equipped with buildings for the foremen and cowboys, with blacksmith and wagon shops, with corrals and fenced lots for the care of the cattle, and sometimes with telephone lines connecting different stations on the ranch.

On account of being much farther south, the cattle do not suffer much from the cold winters and blizzards. But the ranches are more subject to drouths and short grass.

These southern ranges are also largely used for raising cows and young calves, on account of the milder climate. But when the young steers are two or three years old, they are driven by thousands to the northern ranches, where the older cattle can better stand the winters.

The great ranch owners of Texas have also paid much attention to the introduction of the better breeds of cattle. Thoroughbred cattle from England, the Herefords and Durhams, and the Scotch Angus and Galloways, have been imported in large numbers, and at great expense, to take the place of the longhorn, lean Texas breeds, which do

not fatten so well nor produce so good meat. In these ways cattle raising in Texas has become a very skilful and well-regulated business, requiring great experience and intelligence, and yielding large profits to those who are trained and skilful managers. One man who, almost penniless, went into the Texas cattle business at the close of the Civil War, by hard work and diligence has acquired a great ranch, and is estimated to be worth $5,000,000. Nowadays it requires a large capital, both for the purchase of land for range and cattle to stock it. In New Mexico and Arizona, where there is still a free, unfenced range, there are better opportunities for men of small capital.

About one-half of Texas and nearly all of New Mexico and Arizona are devoted to cattle ranges, and about six and a quarter million of cattle are now found on these ranches.

The lack of water on these ranges has been largely supplied by bored wells, which are sunk all over a large ranch wherever it is necessary to have water for the cattle. There are very few rivers or running streams, but the rain that falls during the summer is collected behind dams and where surface lakes can be found. In the region of the staked plain there are many small salt lakes, which are empty in dry seasons, but filled by rains, and they supply an abundance of salt for the cattle.

There are a number of dangers from which the Texas cattlemen must protect their herds as well as they may. Among diseases, blackleg attacks young calves and slays many. A noxious weed called the loco poisons the cattle as opium poisons people. The prairie-dogs do much damage by destroying the grass and by digging holes in which

cattle and horses stumble and are injured. Rattlesnakes poison many, while wolves and panthers and the mountain lion ravage the herds and do much damage. Against all these enemies the cowboys and ranchers wage unceasing war.

As before indicated, the region of country devoted to cattle ranching extends from Canada to southern Texas, and from central Kansas and Nebraska into the Rocky Mountains, including a large share of Montana, Wyoming, and Colorado, nearly the whole of New Mexico and Arizona, and about half of Texas, Indian Territory, Kansas, Nebraska, and the Dakotas. This entire region lies in the arid belt, and does not receive sufficient rainfall for farming, except where irrigation can be carried on in the valleys of the rivers. There is, however, enough rainfall to yield the thin grasses upon which the great ranch herds are grazed. The cause of this arid dryness or lack of rainfall is the presence of the Sierra Nevada and Rocky Mountains, which catch most of the rains and snows brought eastward by the winds from the Pacific, and this leaves the plains to the east of the Rockies short in their rainfall.

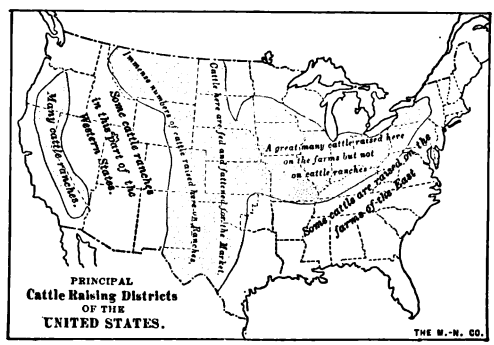


FIG. 75.

Most of the beef cattle produced upon the plains are

FIG. 76.

Pike's Peak, as seen through the Gateway of the Garden of the Gods.

The Gateway is an opening through the vertical wall of red sandstone, some 350 feet in height, which partially bounds on one side the district of curiously shaped rocks known as the Garden of the Gods. But five miles from Colorado Springs, the Garden is a favorite drive for tourists. The view of Pike's Peak as seen through the Gateway is particularly striking.

PIKE'S PEAK AND VICINITY

PIKE'S PEAK is the central mountain of a group or cluster of mountains which together constitute a spur of the main chain of the Rockies, extending eastward into the Great Plain. For this reason Pike's Peak was first seen by the emigrant trains coming from the east, and is still one of the prominent landmarks for those travelling toward the Rocky Mountains. It is surrounded by other peaks and ridges which rise far up into the clear sky of Colorado, but all are dwarfed by the greater altitude of the central peak. It is about seventy miles south of Denver, and its snow-covered summit can be clearly seen from Denver nearly every day in the year. Except on cloudy or foggy days, which are rare in Colorado, it can be seen as plainly as if it were only ten miles away. Fifty miles to the south of it is Pueblo, the city of smelters on the Arkansas, eastward of the Royal Gorge, where the river breaks through the mountain ridge. Pike's Peak stands, therefore, like a huge sentinel, with the wilderness of mountains and park lands at its back and the great level plains at its feet to the east, and the main ridge of the Rocky Mountains a little back, but flanking it on the north and south.

The summit of Pike's Peak rises 14,140 feet above the sea-level, but the Great Plain at its base is 6000 feet above the sea, and the peak therefore rises only about 8000 feet above the general level of the surrounding country.

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cropped, the grass dies out, and the land becomes almost worthless for range. The cattlemen themselves have been compelled to combine and limit the number of cattle turned loose upon the plains. A single cow or steer requires from fifteen to twenty-five acres of land to supply sufficient grass. In the rich farmlands of Iowa one or two acres would supply enough food for an animal. This shows how sparse and thin the western grass is.

The western part of Texas is most favorably situated for the cattle business, and here are found the greatest cattle ranches. Wealthy men have bought up or leased from the state of Texas large areas of country, which they surround with wire fences and use for cattle ranges.

In the *Review of Reviews* for September, 1901, Mr. Barker says: "Texas is noted for the number and extent of its ranches. Of a total of several thousand [ranches], they vary in size from a few thousand to several million acres, the large ones averaging 50,000 acres. The greatest is the 'X. I. T.,' in the Panhandle, which embraces half a dozen counties and contains nearly 3,000,000 acres. It belongs to the 'Capitol Syndicate,' a company of men who received this vast territory some twenty years ago in return for providing the magnificent state house at Austin. The ranch is divided into seven divisions, each managed by a foreman, and each connected with the headquarters by means of telephones. The whole is run with the system and despatch which characterize all great industries. On this ranch now run considerably over 100,000 head of cattle, and an idea of its size may be gained from the fact that the pasture fence extends 210 miles in one direction and 25 in another, making a total area of about 5000 square miles. From time to time

small parcels of land have been sold, and, meanwhile, valuations have appreciated from fifty cents an acre to four times that amount."

The larger ranches usually have about 50,000 acres each, and are managed by a foreman, who has a good house. There are almost no trees or fuel on the western plains of Texas, and provisions and all the necessaries of the ranch must be hauled hundreds of miles in wagons.

The whole range belonging to the ranch is fenced in, so that the cattle do not wander at will and mix with other herds, and not so many cowboys are needed for the care of the stock. The headquarters of one of these large ranches is completely equipped with buildings for the foremen and cowboys, with blacksmith and wagon shops, with corrals and fenced lots for the care of the cattle, and sometimes with telephone lines connecting different stations on the ranch.

On account of being much farther south, the cattle do not suffer much from the cold winters and blizzards. But the ranches are more subject to drouths and short grass.

These southern ranges are also largely used for raising cows and young calves, on account of the milder climate. But when the young steers are two or three years old, they are driven by thousands to the northern ranches, where the older cattle can better stand the winters.

The great ranch owners of Texas have also paid much attention to the introduction of the better breeds of cattle. Thoroughbred cattle from England, the Herefords and Durhams, and the Scotch Angus and Galloways, have been imported in large numbers, and at great expense, to take the place of the longhorn, lean Texas breeds, which do

not fatten so well nor produce so good meat. In these ways cattle raising in Texas has become a very skilful and well-regulated business, requiring great experience and intelligence, and yielding large profits to those who are trained and skilful managers. One man who, almost penniless, went into the Texas cattle business at the close of the Civil War, by hard work and diligence has acquired a great ranch, and is estimated to be worth $5,000,000. Nowadays it requires a large capital, both for the purchase of land for range and cattle to stock it. In New Mexico and Arizona, where there is still a free, unfenced range, there are better opportunities for men of small capital.

About one-half of Texas and nearly all of New Mexico and Arizona are devoted to cattle ranges, and about six and a quarter million of cattle are now found on these ranches.

The lack of water on these ranges has been largely supplied by bored wells, which are sunk all over a large ranch wherever it is necessary to have water for the cattle. There are very few rivers or running streams, but the rain that falls during the summer is collected behind dams and where surface lakes can be found. In the region of the staked plain there are many small salt lakes, which are empty in dry seasons, but filled by rains, and they supply an abundance of salt for the cattle.

There are a number of dangers from which the Texas cattlemen must protect their herds as well as they may. Among diseases, blackleg attacks young calves and slays many. A noxious weed called the loco poisons the cattle as opium poisons people. The prairie-dogs do much damage by destroying the grass and by digging holes in which

cattle and horses stumble and are injured. Rattlesnakes poison many, while wolves and panthers and the mountain lion ravage the herds and do much damage. Against all these enemies the cowboys and ranchers wage unceasing war.

As before indicated, the region of country devoted to cattle ranching extends from Canada to southern Texas, and from central Kansas and Nebraska into the Rocky Mountains, including a large share of Montana, Wyoming, and Colorado, nearly the whole of New Mexico and Arizona, and about half of Texas, Indian Territory, Kansas, Nebraska, and the Dakotas. This entire region lies in the arid belt, and does not receive sufficient rainfall for farming, except where irrigation can be carried on in the valleys of the rivers. There is, however, enough rainfall to yield the thin grasses upon which the great ranch herds are grazed. The cause of this arid dryness or lack of rainfall is the presence of the Sierra Nevada and Rocky Mountains, which catch most of the rains and snows brought eastward by the winds from the Pacific, and this leaves the plains to the east of the Rockies short in their rainfall.

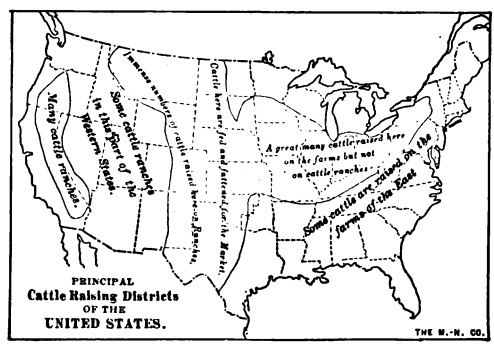

FIG. 75.

Most of the beef cattle produced upon the plains are

driven to the railway stations and shipped to Omaha, Kansas City, Chicago, and other cities. Here are great slaughter-houses, where the animals are prepared for the market. The fresh meat thus prepared is packed in ice and shipped in refrigerator cars to all parts of the United States. In the meat markets it is also stored in large refrigerator rooms and sold out to customers as needed. Much also of this refrigerator fresh meat is shipped from New York and other cities to England, and other parts of Europe. Packed in ice in the ship's hold, it remains fresh for use in London, Paris, and other European cities. Many thousands of live cattle are also shipped in long cattle trains across the continent to New York, where they are transferred to ships and carried to the English market. The live animals must be well fed, watered, and cared for while on rail and on shipboard.

While we speak of the western plains as the cattle region of the United States, many more cattle are raised and marketed from the farms of Illinois, Iowa, Kansas, and the agricultural states than from the western plains. The corn-producing belt is the chief cattle-raising district, because corn is the best feed for fattening cattle. In 1880 New York state had 2,300,000 more cattle than were found at that time in all the great cattle ranch region of the west.

FIG. 76.

Pike's Peak, as seen through the Gateway of the Garden of the Gods.

The Gateway is an opening through the vertical wall of red sandstone, some 350 feet in height, which partially bounds on one side the district of curiously shaped rocks known as the Garden of the Gods. But five miles from Colorado Springs, the Garden is a favorite drive for tourists. The view of Pike's Peak as seen through the Gateway is particularly striking.

PIKE'S PEAK AND VICINITY

PIKE'S PEAK is the central mountain of a group or cluster of mountains which together constitute a spur of the main chain of the Rockies, extending eastward into the Great Plain. For this reason Pike's Peak was first seen by the emigrant trains coming from the east, and is still one of the prominent landmarks for those travelling toward the Rocky Mountains. It is surrounded by other peaks and ridges which rise far up into the clear sky of Colorado, but all are dwarfed by the greater altitude of the central peak. It is about seventy miles south of Denver, and its snow-covered summit can be clearly seen from Denver nearly every day in the year. Except on cloudy or foggy days, which are rare in Colorado, it can be seen as plainly as if it were only ten miles away. Fifty miles to the south of it is Pueblo, the city of smelters on the Arkansas, eastward of the Royal Gorge, where the river breaks through the mountain ridge. Pike's Peak stands, therefore, like a huge sentinel, with the wilderness of mountains and park lands at its back and the great level plains at its feet to the east, and the main ridge of the Rocky Mountains a little back, but flanking it on the north and south.

The summit of Pike's Peak rises 14,140 feet above the sea-level, but the Great Plain at its base is 6000 feet above the sea, and the peak therefore rises only about 8000 feet above the general level of the surrounding country.

The peak was discovered and explored by Colonel Pike in 1806, and received its name from him. When gold was discovered in Colorado in 1858, the Pike's Peak gold region became famous, though no gold was mined in its immediate neighborhood.

The peak itself is not a pointed pinnacle but a great rounded swell of the mountain ridge, steep and rocky on some of its edges, but with long slopes and spurs reaching out toward the neighboring mountain masses. But its sides are seamed with mighty gorges and chasms, glittering with snow and ice. During the greater part of the year the peak is plainly distinguished from the neighboring cones by its greater height and its white, snow-covered top and sides. "The summit is nearly level, embracing about 40 acres, and composed of angular slabs and blocks of coarse, disintegrating granite. It affords one of the grandest views on the North American continent, extending nearly 150 miles in all directions." But it is only occasionally that the tourist can get such a clear view from its summit. But to survey at one sweep a country larger than the state of Illinois is worth the trouble of a mountain climb. Although Colorado has a dry, clear atmosphere and rain is infrequent, the mountain peaks are often wrapped in clouds. The higher ridges and peaks draw the clouds and moisture, though the plains at their feet may be clothed in constant sunlight.

But Pike's Peak itself is only the most prominent among a large group of noteworthy objects in this neighborhood, among which are Manitou and Colorado Springs, the Garden of the Gods, Cheyenne Cañon, Monument Park, Glen Eyre, the Cave of the Winds, besides the foot-

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Manitou is the foremost pleasure resort in Colorado.

The prominence of Manitou is due to the soda and iron springs, highly charged with gas, which boil up through the rocks, and give to the stream, meandering through the town, the name of the "Fontaine qui Bouille." From there is made the ascent of Pike's Peak by either the trail or the Cog Railway.

trail and the railroad to the top of Pike's Peak and many other mountain resorts and scenic wonders. Many thousands of people visit the Pike's Peak country every year, to enjoy the great number of nature's grand and beautiful works.

Just east of the foot of the mountain, on a level plain, six thousand feet above the sea, stands the beautiful city of Colorado Springs, with its shaded streets, fine hotels, and great number of summer homes. Many rich people have built here villas and costly cottages for summer residence. Electric street car lines reach to Manitou and Cheyenne Cañon. Six lines of railway run into Colorado Springs, bringing tourists from all directions. It has become, therefore, in connection with the various mountain resorts, a great centre for pleasure and health seekers from all parts of the United States.

About six miles west of Colorado Springs is Manitou, with its mineral springs. It lies in a deep, narrow valley at the foot of Pike's Peak, with lofty mountain slopes on either side, a mountain stream passing through its centre, and the snow-covered top of the peak seen through a notch in the lower mountains. Beside the mountain stream, in the midst of the town, is a park with mineral springs, where thousands of tourists drink for health or for curiosity. "Manitou lies in a cup-like glen, surrounded by mountains, and has for an impressive background, high above the surrounding summits, the impressive majesty of Pike's Peak. Its regular inhabitants number perhaps two thousand five hundred or two thousand. There are two electric light plants, and three miles of streets lighted by the arc light; a beautiful avenue eighty feet wide runs through the village. On either side of this avenue on the

mountain side may be seen many mansions, villas, and cottages. In the very centre of the town are the springs, enclosed within pleasure grounds, sparkling and bubbling from their hidden reservoirs. Hotels there are in profusion ; boarding-houses, cottages, almost any kind of retreat or home for a traveller." There are also arcade paths, secluded nooks, smooth curving driveways, cool and shady parks, hanging rustic bridges, paths up the mountain sides, and lookout points hundreds of feet above the valley. More than one hundred and fifty thousand people are said to visit this spot every year. Farther up the cañon, toward the foot of Pike's Peak, are iron springs and hotels on the mountain side. Instead of living in hotels or cottages, some people bring tents and camp out along the lower slopes. From Manitou the old trail leads twelve miles to the summit of the peak. A carriage road now also reaches the top. But more comfortable still, a cog-wheel railroad ascends the mountain from Manitou and puts the summit within easy reach of all.

A little north of the road from Colorado Springs to Manitou lies that region of curious wonders known as the Garden of the Gods. It consists of steep, towering rocks rising hundreds of feet into the air, some red like terra-cotta, some nearly white, with here and there curiously fantastic shapes like bears, or elephants, or other animals. As we enter the Garden of the Gods, we "pass in between massive portals of rock, of brilliant terra-cotta red, and enter upon a plain, miles in extent, covered in all directions with magnificent isolated masses of the same striking color, each lifting itself against the wonderful blue of the Colorado sky with great distinctness." It seems as if giants had been at some rude sport and had piled up

these immense slabs as if to astonish the puny race of men. "Here a battlemented wall is pierced by a round window; there a cluster of slender spires lift themselves; beyond, a leaning tower starts upward and a cube of rock as large as a dwelling-house is balanced on a pivot-like point at the base, as if a child's strength could upset it." In the background of all this is the great mountain wall, with the white summit of the giant peak above.

A few miles to the south, but easily reached by carriage or by electric car from Colorado Springs, is Cheyenne Cañon, a deep gorge in the foot-hills, through which a mountain stream flows. The cañon is narrow and deep and winding, the dark rocks towering hundreds of feet perpendicularly above the path at the bottom. After an hour's walk or ride up through the cañon, we reach the foot of the seven falls or the successive springs of this mountain stream, as it comes leaping down the mountain sides to reach the more level bottom of the rocky gorge. The scenery of this cañon is very impressive.

One of the most interesting experiences of this mountain region is an old-fashioned trip on foot or on horseback from Manitou to the summit of Pike's Peak. We secured saddle-horses, and set out in the morning, about eight o'clock, for the twelve-mile journey. Passing the iron spring, from which we drank strength for the journey, we entered the great cañon of the Pike's Peak trail, and followed it for six miles or more. It is a continuation of the vale in which Manitou lies, a crooked, winding valley, rising steadily upward. The mountain sides which formed its borders were sometimes covered with forests of evergreen. Close to the mountain torrent, and sometimes mingled with the pines, were groves of cottonwood. The

lower valley was strewn with mighty boulders, as tall as the tree-tops, and standing alone, as if some giant hand had hurled them from the mountain tops. The path rose sometimes many feet above the stream, and again ran close by its side, giving great variety of beautiful pictures of this winding valley. The trees, flowers, and grasses were all in the freshness of June. But when we reached the end of this cañon, and turned on our track to climb the rugged back-bone of the giant, the scenery was almost entirely changed. It was too steep to go straight up the slope, so we went up long, slanting paths, along the side of the mountain, round projecting spurs, and at times zigzagging our way, till we were beyond timber-line, eleven thousand feet above the sea. From here on the journey upward was a dismal one, so far as the mountain on which we were climbing was concerned. It was simply a rough, rocky path up a bleak and barren mountain side; but we began now to get magnificent views of mountain ranges and peaks in the distance. Gradually the surrounding summits began to sink beneath our feet, and we could see distant mountain chains a hundred and more miles away. A vast wilderness of mountain scenery opened out toward the west, to the south and north, and now and then we would catch a glimpse of the level plains stretching eastward. It grew cloudy as we ascended, and our view of the mountains was not constant. Before reaching the summit, a passing cloud enveloped us in its chilly folds, and we could see nothing. A half-mile or more before sighting the top we came upon a wide snowdrift, and leaving our horses we scrambled across the snow and up a rocky path for some distance, and came out upon the broad summit of the mountain, strewn with such big granite boulders that it was

difficult in most places to walk about. The summit house was a low stone structure, with heavy walls to prevent blowing down. For the wind frequently blows at a terrific speed across this summit. They furnished us with hot coffee, and we spent two hours on the top before starting home again. Fogs or clouds were hanging about the brow of the mountain, and sometimes drifted across its top, and our views from the summit were not full and clear, but we could catch occasional views of Manitou, Colorado Springs, and the eastern plains, and of the mighty wilderness of mountains on the other side. We also walked about the summit, and tried to peer down the great gorges which seam the mountain on two sides.

The rarefied air of the mountain top gave some of us a headache, and we were not sorry to start home again. At this time the government kept up a signal station at the top. Two men remained on the peak, even in winter, and telegraphed daily the weather observations to Colorado Springs. In winter snow and ice were piled up many feet deep about the summit house, and they could not venture out for three months or more. As we descended upon our homeward journey, a heavy storm of rain came up and gave us such a thorough soaking for two hours that we were fully convinced that the rains in Colorado love the mountain slopes. About six o'clock in the evening we rode into Manitou, stiff, hungry, and drenched, and almost completely exhausted after twenty-four miles of mountaineering.

A trip by rail would be doubtless much easier and more comfortable, but a trip on foot or on horseback gives the best opportunities for sight-seeing, and for those who wish to catch the spirit of the mountains and drink in its

rugged strength and health a foot journey is the opportunity.

Many people spend a month or two among these mountains, climbing the ridges and mountain paths, drinking of the mineral springs, taking in the pure and bracing air of this elevated region and enjoying the immense variety and grandeur of mountain scenery and life. There are very many other interesting places deserving a full description, such as the Cave of the Winds, with its labyrinth of caverns and beautiful grottos. We entered it from a mountain side two or three hundred feet above the bottom of the valley. Monument Park, also, with its host of sculptured forms in rock as nature has chiselled them out, Glen Eyre, near the Garden of the Gods, with its chimneyed rocks and grand mountain gorge, are much visited. But there is no limit to the attractions of such a wonderland of mountains and valleys. The Colorado Midland Railroad passes up through the valley beyond Manitou, and at Green Mountain Falls, nine miles from Manitou, is a beautiful summer home, eight thousand feet above the sea, with hotels, springs, and a deep valley set in surrounding mountains to protect it from the storms.

IRRIGATION AND THE BIG DITCH AT DENVER

THE city of Denver lies in the valley of the south fork of the Platte River about twenty-two miles northeast of the point at which the river emerges from the foot-hills and starts northeastward across the plains to join the north fork of the Platte and move eastward to the Missouri. In 1880 the big irrigating ditch was dug so as to draw its waters from the south fork of the Platte and distribute them along the gentle slope southeast of the river. About forty miles south of Denver is a plateau extending out from the mountains into the plains and forming a divide or watershed between the Arkansas on the south and the Platte on the north. For many miles, therefore, the plains slope gently from the divide toward the northwest down to the south fork of the Platte. This gently sloping plain is a part of the region known as "the Plains," lying just east of the Rocky Mountains. It is a dry, treeless land with a scanty grass and cactus growth. The soil is sandy but rich, and if well supplied with water, produces excellent crops of grain, grass, and vegetables. But the rainfall for the whole year is very light and cannot be depended upon for crops, while even the thin buffalo grass will feed only a small part of the stock which a good meadow of equal area does. The early settlers in Colorado were either miners or grazers and stockmen. But as cities and towns sprung up along the mountains, agriculture along the river val-

leys began to attract attention, and the water was drawn out from the rivers and streams into ditches to irrigate the growing crops. The first ditches were small and were taken out by a few farmers whose land lay in the bottoms and near the rivers. Some ten years earlier a larger ditch, called the City Ditch, was taken from the river at Littleton, ten miles south of Denver, and carried along the slope back from the river toward Denver. It passed just east of the city and along the plain above, so that its water was drawn off not only for farms, but to run through the streets of Denver to water gardens and the cottonwood and maple and other trees which shaded the streets of the city.

With the great increase in population at Denver and all along the mountains, in mining towns, the demand for agricultural products became greater, and as they had to be shipped from Kansas or Utah, three or four hundred miles, the impulse became strong to bring much larger territories under the irrigating canals. A wealthy company therefore secured the privilege of constructing a great irrigating ditch so as to bring in a large part of the southeast slope of the Platte River under water, and thus open up a strip of irrigation many miles long and from two to twenty miles wide.

In order to get the water at a high level and thus carry it as far back upon the plains as possible, a dam was built in the river three or four miles up the cañon, which the river has cut through the mountains before coming out into the plain. A heavy framework of timbers was built across the stream and boarded up so as to make a solid dam, and from it boards were sloped down on the lower side over which the excess of water flowed. The big ditch was

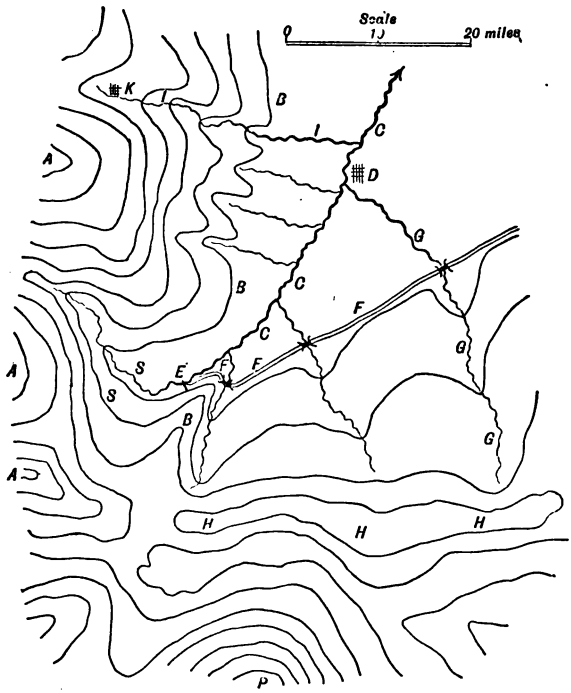

FIG. 78.

A. A. A. — Main chain of the Rocky Mountains.
B. B. B. — Foot-hills.
C. C. C. — South Fork of the Platte.
D. — Denver.
E. — The dam.
F. F. F. — The ditch.
G. G. G. — Cherry Creek.
H. H. H. — Watershed.
I. I. — Clear creek.
K. — Georgetown.
P. — Pike's Peak.
S. S. — South Park.

taken out of the river from the side of the dam much as a mill-race is taken from a stream. A way was made for this artificial canal along the cañon three or four miles till the mouth was reached. But the cañon is narrow in places and crooked, and lined with mountains from five hundred to one thousand feet high. In one place it was necessary to cut a tunnel out of solid rock five hundred feet through a spur of a mountain, through which the canal flows. In several places where the cañon is narrow and the sides steep, with rocky cliffs, a great wooden trough was built along the side of the mountain and supported by heavy braces, and the water carried through this. As the descent of the river is much more rapid than that of the canal, at the point where the river and canal emerge from the mountain, the canal is twenty or more feet higher than the current of the river. At this point the canal diverges from the river, and is carried back as far as its elevation, and a gentle slope so as to produce a current, will allow.

After the canal is brought out of the foot-hills and away from rough hilly country near them to the more regular slope of the plain, we may get a more accurate notion of its size. The digging of this great ditch required the work of hundreds of men with horses, scrapers, and other machines. The canal is forty feet wide at the bottom and seven feet deep when the water is turned on. The dirt as it was taken out was thrown mostly upon the lower side toward the river, so as to form an embankment on that side. In many places the dirt was piled up fifteen or twenty feet high, and the cuts resembled a great railroad cut, only wider. The work of excavation was carried on for months along this line with many men who lived in tents and with much expenditure of capital.

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About six miles west of Colorado Springs is Manitou, with its mineral springs. It lies in a deep, narrow valley at the foot of Pike's Peak, with lofty mountain slopes on either side, a mountain stream passing through its centre, and the snow-covered top of the peak seen through a notch in the lower mountains. Beside the mountain stream, in the midst of the town, is a park with mineral springs, where thousands of tourists drink for health or for curiosity. "Manitou lies in a cup-like glen, surrounded by mountains, and has for an impressive background, high above the surrounding summits, the impressive majesty of Pike's Peak. Its regular inhabitants number perhaps two thousand five hundred or two thousand. There are two electric light plants, and three miles of streets lighted by the arc light; a beautiful avenue eighty feet wide runs through the village. On either side of this avenue on the

mountain side may be seen many mansions, villas, and cottages. In the very centre of the town are the springs, enclosed within pleasure grounds, sparkling and bubbling from their hidden reservoirs. Hotels there are in profusion ; boarding-houses, cottages, almost any kind of retreat or home for a traveller." There are also arcade paths, secluded nooks, smooth curving driveways, cool and shady parks, hanging rustic bridges, paths up the mountain sides, and lookout points hundreds of feet above the valley. More than one hundred and fifty thousand people are said to visit this spot every year. Farther up the cañon, toward the foot of Pike's Peak, are iron springs and hotels on the mountain side. Instead of living in hotels or cottages, some people bring tents and camp out along the lower slopes. From Manitou the old trail leads twelve miles to the summit of the peak. A carriage road now also reaches the top. But more comfortable still, a cog-wheel railroad ascends the mountain from Manitou and puts the summit within easy reach of all.

A little north of the road from Colorado Springs to Manitou lies that region of curious wonders known as the Garden of the Gods. It consists of steep, towering rocks rising hundreds of feet into the air, some red like terra-cotta, some nearly white, with here and there curiously fantastic shapes like bears, or elephants, or other animals. As we enter the Garden of the Gods, we "pass in between massive portals of rock, of brilliant terra-cotta red, and enter upon a plain, miles in extent, covered in all directions with magnificent isolated masses of the same striking color, each lifting itself against the wonderful blue of the Colorado sky with great distinctness." It seems as if giants had been at some rude sport and had piled up

these immense slabs as if to astonish the puny race of men. "Here a battlemented wall is pierced by a round window; there a cluster of slender spires lift themselves; beyond, a leaning tower starts upward and a cube of rock as large as a dwelling-house is balanced on a pivot-like point at the base, as if a child's strength could upset it." In the background of all this is the great mountain wall, with the white summit of the giant peak above.

A few miles to the south, but easily reached by carriage or by electric car from Colorado Springs, is Cheyenne Cañon, a deep gorge in the foot-hills, through which a mountain stream flows. The cañon is narrow and deep and winding, the dark rocks towering hundreds of feet perpendicularly above the path at the bottom. After an hour's walk or ride up through the cañon, we reach the foot of the seven falls or the successive springs of this mountain stream, as it comes leaping down the mountain sides to reach the more level bottom of the rocky gorge. The scenery of this cañon is very impressive.

One of the most interesting experiences of this mountain region is an old-fashioned trip on foot or on horseback from Manitou to the summit of Pike's Peak. We secured saddle-horses, and set out in the morning, about eight o'clock, for the twelve-mile journey. Passing the iron spring, from which we drank strength for the journey, we entered the great cañon of the Pike's Peak trail, and followed it for six miles or more. It is a continuation of the vale in which Manitou lies, a crooked, winding valley, rising steadily upward. The mountain sides which formed its borders were sometimes covered with forests of evergreen. Close to the mountain torrent, and sometimes mingled with the pines, were groves of cottonwood. The

lower valley was strewn with mighty boulders, as tall as the tree-tops, and standing alone, as if some giant hand had hurled them from the mountain tops. The path rose sometimes many feet above the stream, and again ran close by its side, giving great variety of beautiful pictures of this winding valley. The trees, flowers, and grasses were all in the freshness of June. But when we reached the end of this cañon, and turned on our track to climb the rugged back-bone of the giant, the scenery was almost entirely changed. It was too steep to go straight up the slope, so we went up long, slanting paths, along the side of the mountain, round projecting spurs, and at times zigzagging our way, till we were beyond timber-line, eleven thousand feet above the sea. From here on the journey upward was a dismal one, so far as the mountain on which we were climbing was concerned. It was simply a rough, rocky path up a bleak and barren mountain side; but we began now to get magnificent views of mountain ranges and peaks in the distance. Gradually the surrounding summits began to sink beneath our feet, and we could see distant mountain chains a hundred and more miles away. A vast wilderness of mountain scenery opened out toward the west, to the south and north, and now and then we would catch a glimpse of the level plains stretching eastward. It grew cloudy as we ascended, and our view of the mountains was not constant. Before reaching the summit, a passing cloud enveloped us in its chilly folds, and we could see nothing. A half-mile or more before sighting the top we came upon a wide snowdrift, and leaving our horses we scrambled across the snow and up a rocky path for some distance, and came out upon the broad summit of the mountain, strewn with such big granite boulders that it was

difficult in most places to walk about. The summit house was a low stone structure, with heavy walls to prevent blowing down. For the wind frequently blows at a terrific speed across this summit. They furnished us with hot coffee, and we spent two hours on the top before starting home again. Fogs or clouds were hanging about the brow of the mountain, and sometimes drifted across its top, and our views from the summit were not full and clear, but we could catch occasional views of Manitou, Colorado Springs, and the eastern plains, and of the mighty wilderness of mountains on the other side. We also walked about the summit, and tried to peer down the great gorges which seam the mountain on two sides.

The rarefied air of the mountain top gave some of us a headache, and we were not sorry to start home again. At this time the government kept up a signal station at the top. Two men remained on the peak, even in winter, and telegraphed daily the weather observations to Colorado Springs. In winter snow and ice were piled up many feet deep about the summit house, and they could not venture out for three months or more. As we descended upon our homeward journey, a heavy storm of rain came up and gave us such a thorough soaking for two hours that we were fully convinced that the rains in Colorado love the mountain slopes. About six o'clock in the evening we rode into Manitou, stiff, hungry, and drenched, and almost completely exhausted after twenty-four miles of mountaineering.

A trip by rail would be doubtless much easier and more comfortable, but a trip on foot or on horseback gives the best opportunities for sight-seeing, and for those who wish to catch the spirit of the mountains and drink in its

rugged strength and health, a foot journey is the opportunity.

Many people spend a month or two among these mountains, climbing the ridges and mountain paths, drinking of the mineral springs, taking in the pure and bracing air of this elevated region, and enjoying the immense variety and grandeur of mountain scenery and life. There are very many other interesting places, deserving a full description, such as the Cave of the Winds, with its labyrinth of caverns and beautiful grottos. We entered it from a mountain side two or three hundred feet above the bottom of the valley. Monument Park, also, with its host of sculptured forms in rock as nature has chiselled them out, Glen Eyre, near the Garden of the Gods, with its chimneyed rocks and grand mountain gorge, are much visited. But there is no limit to the attractions of such a wonderland of mountains and valleys. The Colorado Midland Railroad passes up through the valley beyond Manitou, and at Green Mountain Falls, nine miles from Manitou, is a beautiful summer home, eight thousand feet above the sea, with hotels, springs, and a deep valley set in surrounding mountains to protect it from the storms.

IRRIGATION AND THE BIG DITCH AT DENVER

THE city of Denver lies in the valley of the south fork of the Platte River about twenty-two miles northeast of the point at which the river emerges from the foot-hills and starts northeastward across the plains to join the north fork of the Platte and move eastward to the Missouri. In 1880 the big irrigating ditch was dug so as to draw its waters from the south fork of the Platte and distribute them along the gentle slope southeast of the river. About forty miles south of Denver is a plateau extending out from the mountains into the plains and forming a divide or watershed between the Arkansas on the south and the Platte on the north. For many miles, therefore, the plains slope gently from the divide toward the northwest down to the south fork of the Platte. This gently sloping plain is a part of the region known as "the Plains," lying just east of the Rocky Mountains. It is a dry, treeless land with a scanty grass and cactus growth. The soil is sandy but rich, and if well supplied with water, produces excellent crops of grain, grass, and vegetables. But the rainfall for the whole year is very light and cannot be depended upon for crops, while even the thin buffalo grass will feed only a small part of the stock which a good meadow of equal area does. The early settlers in Colorado were either miners or grazers and stockmen. But as cities and towns sprung up along the mountains, agriculture along the river val-

leys began to attract attention, and the water was drawn out from the rivers and streams into ditches to irrigate the growing crops. The first ditches were small and were taken out by a few farmers whose land lay in the bottoms and near the rivers. Some ten years earlier a larger ditch, called the City Ditch, was taken from the river at Littleton, ten miles south of Denver, and carried along the slope back from the river toward Denver. It passed just east of the city and along the plain above, so that its water was drawn off not only for farms, but to run through the streets of Denver to water gardens and the cottonwood and maple and other trees which shaded the streets of the city.

With the great increase in population at Denver and all along the mountains, in mining towns, the demand for agricultural products became greater, and as they had to be shipped from Kansas or Utah, three or four hundred miles, the impulse became strong to bring much larger territories under the irrigating canals. A wealthy company therefore secured the privilege of constructing a great irrigating ditch so as to bring in a large part of the southeast slope of the Platte River under water, and thus open up a strip of irrigation many miles long and from two to twenty miles wide.

In order to get the water at a high level and thus carry it as far back upon the plains as possible, a dam was built in the river three or four miles up the cañon, which the river has cut through the mountains before coming out into the plain. A heavy framework of timbers was built across the stream and boarded up so as to make a solid dam, and from it boards were sloped down on the lower side over which the excess of water flowed. The big ditch was

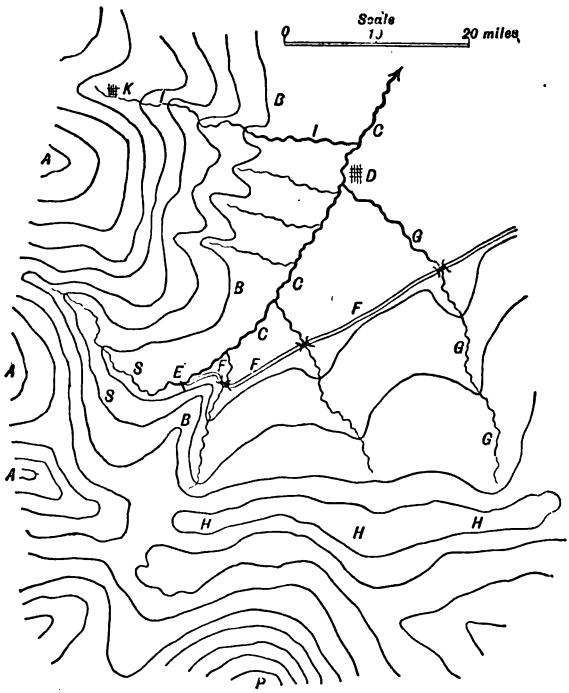

FIG. 78.

A. A. A. — Main chain of the Rocky Mountains.
B. B. B. — Foot-hills.
C. C. C. — South Fork of the Platte.
D. — Denver.
E. — The dam.
F. F. F. — The ditch.
G. G. G. — Cherry Creek.
H. H. H. — Watershed.
I. I. — Clear creek.
K. — Georgetown.
P. — Pike's Peak.
S. S. — South Park.

taken out of the river from the side of the dam much as a mill-race is taken from a stream. A way was made for this artificial canal along the cañon three or four miles till the mouth was reached. But the cañon is narrow in places and crooked, and lined with mountains from five hundred to one thousand feet high. In one place it was necessary to cut a tunnel out of solid rock five hundred feet through a spur of a mountain, through which the canal flows. In several places where the cañon is narrow and the sides steep, with rocky cliffs, a great wooden trough was built along the side of the mountain and supported by heavy braces, and the water carried through this. As the descent of the river is much more rapid than that of the canal, at the point where the river and canal emerge from the mountain, the canal is twenty or more feet higher than the current of the river. At this point the canal diverges from the river, and is carried back as far as its elevation, and a gentle slope so as to produce a current, will allow.

After the canal is brought out of the foot-hills and away from rough hilly country near them to the more regular slope of the plain, we may get a more accurate notion of its size. The digging of this great ditch required the work of hundreds of men with horses, scrapers, and other machines. The canal is forty feet wide at the bottom and seven feet deep when the water is turned on. The dirt as it was taken out was thrown mostly upon the lower side toward the river, so as to form an embankment on that side. In many places the dirt was piled up fifteen or twenty feet high, and the cuts resembled a great railroad cut, only wider. The work of excavation was carried on for months along this line with many men who lived in tents and with much expenditure of capital.

A number of ravines and gullies had to be crossed as the ditch was extended. From the high divide streams of water come rushing down to the Platte in the rainy season. During most of the summer these gulches are dry. Cherry Creek, which enters the Platte at Denver, is a large stream in the rainy season but nearly dry during the summer. Its valley is half a mile wide and twelve to twenty feet below the level of the plain. The big ditch had to be carried across all these gullies and valleys. Generally the ditch is brought to the edge of the valley and carried over a large wooden trough to the other side. This trough or flume must be deep and wide enough to carry the full stream of water. It is built upon piles and wooden trestles like a railroad bridge. The seams and cracks between the boards are calked up so as to cause as little leakage as possible.

In some places dams are built across the valleys and the water run in so as to form a large lake or reservoir extending some distance back up the valley. Sometimes the water is run on to tracts of low level land and a bank extended along the lower side, forming a shallow lake. These reservoirs are filled with water during the rainy season when the showers fall in April and the snows melt on the mountains. At this season the rivers are usually flooded for a short period and an immense amount of water escapes down the river unless it is stored up in the reservoirs. If stored up, it will prove very valuable later during the long, dry summer, when there are few or no rains. The mountains are the original reservoirs of moisture. Much more snow and rain fall in the mountains than on the plains. The cold mountain sides bring out the moisture, and it is condensed into rain and snow. The

mountain peaks have frequent rain-storms and snows when no moisture falls upon the plains. The forests and other vegetation in the mountains also help to hold the snow and moisture. But in spite of all this, the rivers do not furnish enough water to supply all the ditches taken from the river. The best way to increase the water supply so as to be able to irrigate large tracts of country is to collect in reservoirs the waters which are so abundant at the time of the spring freshets.

When the big ditch has been liberally supplied with water, it can be drawn off through wooden boxings to irrigate the separate fields. Usually a larger boxing lets out enough water to form quite a good-sized ditch, from two to six feet across. This may skirt the edges of a number of farms, and from it the water is turned off in smaller channels still to the separate farms and fields. The boxing through which the water escapes from the main ditch passes under the embankment on the lower side. At one end it is below the level of the water in the ditch; at the other end is an upright slide or board, which by being lifted lets out the water, or by dropping and throwing loose dirt into the boxing stops the flow of water. Regular officers, or water inspectors, are appointed by the ditch company to pass along the ditches daily and regulate the amount of water sent out to the different farms; to keep watch of the ditch, reservoirs, banks, and flumes and to see that all are kept in good repair. Sometimes, in case of rains and freshets, there is danger that the ditch may fill up and overrun its banks, thus wasting the water and ruining the crops. In such cases the water is often turned out at the flumes and allowed to run down the valleys to the Platte.

The fields are irrigated in different ways. A wheat-field or meadow is sometimes flooded, that is, the water turned on till the whole area has been overflowed and soaked. In a corn-field the water often runs down in a small stream between each two rows and allowed to soak into the ground till all is moistened. When sufficient moisture is secured, the mouth of the ditch is closed up with a shovel of dirt, and for a week or two, perhaps, the ground may not be flooded again. Most of the land slopes so regularly and evenly toward the river that it is possible to irrigate it all and not allow the soil to wash down.

The ditch company usually sells the water to the farmers by the inch, the amount of water passing through a hole an inch square being sufficient to irrigate an acre. The cost of water is from $1.50 to $2.50 an inch. If the ditch company owns the land it is leased at a rental for water rights. The ditch company, having spent large sums of money in constructing the ditch, must get its reward in the form of water rent from the farmers whom it supplies.

The effect of bringing a district of country under irrigation is very striking. Fields of grain, meadows of alfalfa, and other grasses, corn, and vegetables, grow in abundance. The country that once had much the appearance of a desert is clothed with varieties of green. Shade trees and orchards are planted and thrive, houses and barns built, and the whole country takes on much of the appearance of a blooming Illinois prairie in springtime. The whole ground becomes so saturated with moisture that wells are dug and supply abundance of water so long as the water in the ditch remains. In the fall and winter the ditches are usually allowed to run dry, as the water is

not needed. Land lying below the level of the ditch becomes worth $40 or $50 per acre, while just as good land above the level of the ditch and perhaps only a few rods away is not worth more than $5 or $6 an acre for grazing purposes. Of course roads are opened and bridges across the ravines are built, and the markets of Denver and other towns supplied with abundance of vegetables, small fruit, and grain. It is claimed by those who farm by irrigation that it is a more reliable and satisfactory method than farming in Illinois or Iowa, where dependence must be placed upon the natural rainfall. Sometimes the rains do not come; sometimes they are too abundant and they are not sufficiently regular; but in a country cultivated by irrigation the water can be turned on when needed and in the quantity desired. The abundant sunshine also helps to ripen the fruits better, gives them a better color and flavor. On the other hand, it can be said that only a small part of the western country can ever be irrigated, as there are not sufficient rivers nor supplies of water for the needs.

There is also constant conflict as to water rights. The old ditches first taken out have the prior claim upon the water. According to the law they have the first claim. The big ditch at Denver, though taken out much higher up the river, is not allowed to take so much water as to leave the old ditches farther down the stream without supplies. But it is very difficult to regulate such a thing as flowing water and do justice to all parties. The state legislature at Denver, to avoid conflict, makes laws to regulate the construction and operation of ditches, and provides for water commissioners who constantly supervise them.

The northeast slope of the Platte River is supplied with water in a different way. Quite a number of small streams come down out of the mountains and foot-hills and move eastward across the slope to join the Platte. Between the river and the mountains at Denver, this rich level or rolling plain is about ten miles wide, and is a garden of beauty and abundance. These small mountain streams are dammed up at favorable points so as to form

FIG. 79.

Reservoir, with spillway near the rocks and flume in the centre.

ponds or lakes; from one of these reservoirs the water can be carried in small ditches to the level fields a little lower down on both sides of the valley. As one stands on the mountain, fifteen hundred feet above the level of the plain, he can count scores of these small artificial lakes which preserve the abundance of water of the spring season for the use of the farmers in summer time.

It is a matter of much importance to the farmers along the river valleys that the forests in the mountain slopes be

preserved so that the snows and rains may be kept in reserve along these slopes. All through the mountains the woodsmen and the sawmills have been at work cutting out the best pine timber for use in building. It is quite important that the forests be preserved, and the springs in the mountains be kept flowing. It is also well to encourage the grasses and grass lands upon the mountain slopes and in the valleys, as they, too, help to keep the mountains a permanent reservoir of the rains and snows.

FIG. 80.

Water for irrigation is often conducted around the mountain sides in a flume.

An examination of a large map will show how many streams there are flowing eastward from the Rocky Mountains across the plains that may be found useful for the purposes of irrigation. Even such a large stream as the Arkansas has been used very extensively for the purpose of supplying large irrigating ditches. The upper valley of the Rio Grande is a beautiful and fruitful region, made so by irrigation.

It may be well also to study the map, not only locating the principal rivers and their tributaries flowing down to the plains, but notice also the line in Central Kansas and Nebraska which separates the arid region of the west from the prairies and rainy country to the east, where crops may be raised without artificial means.

A line drawn through central Kansas and Nebraska from north to south along the 100th meridian would fairly separate the arid region of the west from the rainy regions of the east.

It may be noted briefly here, also, that most of the western states and territories must depend in the future for their agricultural development upon irrigation. The

FIG 81.

An irrigation ditch that supplies water to some of the orange groves of southern California.

fruitful valleys of Utah and California and other western states, depend upon this means of supplying moisture to the fields.

In some of the states, like Dakota and Texas, resort has been had to artesian wells, and this method may fairly be compared with the other means of supplying water to the growing crop.

The study of irrigation as given in the preceding sketch, not only gives an insight into the methods of agriculture in nearly half of our own domain, but it will be found very helpful in explaining similar conditions and agricul-

ture in Africa, in Mexico, and in Central and Western Asia, in India, and even in European lands where the water

FIG. 82.

Salt Lake and Jordan Canal, Utah, with headgate to regulate the flow of water. Willows on the bank of the canal; cottonwood trees farther back. The great bar at the point of the mountain in the background.

from rivers is and has been so much used in aiding the cultivation of the soil.

THE GREAT BASIN OF UTAH AND NEVADA

BETWEEN the Wasatch Mountains on the east and the Sierra Nevada of California on the west lies a region of

FIG. 83.

A map to show the rainfall of the United States in inches ; that is, the number of inches of water that would collect all over the surface in a year if all the rain remained where it fell.

desert wastes, salt lakes, and plateaus cut up by short mountain chains, whose drainage has no outlet to the sea. It is a broken plateau between four thousand and five thousand feet above the sea-level, and is a little larger than France.

On the south of this region lies the plateau of the Colorado River with its deep cañons, separated by only a

slight watershed from the Great Basin. On the north also the watershed between the Snake River and the Great Basin is irregular and difficult to determine.

This whole region is arid, having only a slight rainfall, owing to the high Sierra Nevada range, which intercepts the wet winds coming from the Pacific and causes their moisture to fall in rains and snows upon the western mountains. As these winds pass over to the plateau, they are mostly dry.

On the east, the great Rocky Mountain chain likewise takes most of the moisture from the winds from the Gulf of Mexico and the Mississippi Valley.

In addition to these causes the plateau in summer time is hot, and the ascending column of hot air dissipates what clouds would be formed over the plateau. This is especially true in the southern part of the plateau and in the Colorado basin, so that refreshing showers are also cut off in that direction.

Such rains as do fall within the basin are mostly along the ridges of the higher mountain chains, such as the Wasatch and the eastern slopes of the Sierra Nevada, which also get a part of the snows and rains from the Pacific. From these mountain slopes descend the streams which supply the salt lakes and sinks with water; *e.g.* Bear River and the Jordan, flowing into Salt Lake; the Truckee River, flowing into Pyramid and Winnemucca lakes, near the Sierra Nevada; and the Humboldt, flowing into Humboldt and Carson sinks; also the Sevier River and Lake.

Most of the lower mountain ridges crossing this plateau extend from north to south and are barren, rising precipitously in many places out of the plateau. In a few places they are cut through by rivers forming gorges

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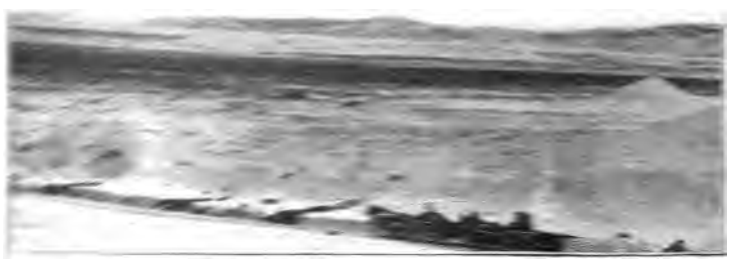

Fig. [illegible]

The [illegible] near Great Salt Lake, where there is no fresh water, [illegible] and where there is very little vegetation.

In the early caravan days to California the passage of the pioneers across the deserts of Utah was marked by great sufferings and losses.

Agriculture is possible only where the rivers can be used as irrigating streams, which is especially the case with those small rivers flowing into the Great Salt Lake. Irrigation, however, takes up so much of the river waters that the lakes receive a smaller part and are reduced in size. In the valleys where irrigating ditches can be used the soil is productive. Such valleys at the western foot of the Wasatch Mountains are very fruitful, with farms and

gardens and many prosperous villages and towns. The streams which flow westward from the Wasatch Mountains have cut deep, narrow cañons, like those of the American Fork and Big Cottonwood, having walls four thousand feet high and presenting grand scenery. Breaking over ledges and rocks, the falls and rapids of these streams supply also a great water-power.

In passing from the deserts southwest of Salt Lake, to the top of the Wasatch Mountains, a remarkable variety of scenery and vegetation is presented. The great desert itself, one hundred miles long and forty miles wide, is an absolute waste, dreary and desolate. East of this the plains are covered with sagebrush, cacti, rabbit bush, mesquit, and the thin desert grass. Out of this plain rise steep, narrow mountain ridges, sometimes a mile high.

"Throughout the lower slopes, low hills and table-lands and below the oak zone, but not in the valleys, Utah is everywhere covered by large areas of juniper, called cedar, and also by piñon. The piñon is a small pine tree, seldom reaching thirty feet in height, which bears a large seed that has been the main support of the Indians for ages. The juniper is also a scraggly bush or small tree of about the same size. Both of these are evergreens, and produce large quantities of resin, and are everywhere used for posts and fuel."[1]

Above this the mountain sides are covered with scrub oak, aspen, and various evergreen trees; sometimes in large forests, supplying excellent lumber, as in the case of the yellow pine, spruce, and red pine. The lumber-producing forests are confined mostly to high ridges and plateaus.

From the top of the Wasatch peaks one may see spread

[1] Tarr and McMurry's Geography, Supplementary Volume, Utah.

out before him, as on a map, the valleys, cities, and towns of Utah. The air is so clear that one may see more than a hundred miles, and distant objects seem to draw near and stand out clearly. From these summits the eastern edge of the Great Basin can be clearly surveyed for two hundred miles at a single view.

In the early springtime the lower plains are covered with a profusion of brilliant flowers, brought into life by

FIG. 85.
Salt Lake City and the Wasatch Range.

the early spring rains. But they quickly disappear, and only the ripened seeds remain in the soil awaiting another season of showers.

"Since but little of Utah is capable of irrigation because of the lack of water, the land is uncultivated by farmers, and would be useless were it not for the scanty vegetation which grows on the deserts and the abundant grass which once covered the mountains. The people early began raising cattle, horses, mules, and sheep, till now the animals are

counted by the millions. The grass growing on the deserts has the peculiarity of drying up and still retaining its nourishment, so the stock spread out over the deserts and live upon this grass. In addition there are certain shrubs which furnish the greater part of the sustenance for stock. The chief of these is the winter fat, a low shrub which is eaten close to the ground, and is very nourishing because of the abundant seed which it produces, and which remains on the stems during the winter. There are two other shrubs upon which the sheep depend besides the winter fat. One of them is the shad-scale, a thorny shrub belonging to the beet family, and the other the gray, but evergreen, sagebrush. When the snows begin to melt off the deserts, so that the stock can no longer secure water to drink, the animals drift back to the mountains and follow the retreating snow, till in the height of summer most of the animals are found grazing on the highest mountains. The number of cattle raised is 400,000; sheep, 3,300,000; total sheep owned in Utah, 6,000,000."[1]

Great Salt Lake, in the extreme northern part of the Great Basin, has a history which is one of the most interesting chapters in the geography of North America. The lake itself, whose surface is about 4205 feet above sea-level is 70 miles long and has an average width of some 30 miles and an area of 1700 square miles. Its average depth is 12 feet. Travellers in crossing the mountains, when first coming in sight of this wide-spreading lake, have expressed their surprise at the grand view of this extensive inland sea, surrounded by high mountains.

But geologists and geographical explorers, by studying the plains and mountain sides which surround this lake,

[1] Tarr and McMurry's Geography, Supplementary Volume, Utah.

have found out that it was once more than ten times as large as now, that is, 18,000 square miles in extent, that it was 1200 feet deep in places, and instead of being so intensely salt as now, was a fresh-water lake, abounding in salmon, whitefish, trout, and other fresh-water fish, and that its outlet was a broad, deep stream at what is

FIG. 86.

Old outlet of Great Salt Lake at Red Rock Gap. The level part in the middle is about a quarter of a mile wide, and was the bottom of the river. The hills in the foreground were cliffs on the edge of the river. The table-land in the background was the shore when the lake was the highest.

now known as Red Rock Gap, where it passed through the hills northward to join the Snake River.

One of the most easily seen proofs of the greater size of this lake in former times is the old beach levels or shores of the lake found along the mountain sides 600 feet and more above the present level of the lake. Where rivers entered the lake, they also built broad, flat deltas. These old beach levels and deltas which line the valleys are sometimes called benches, and they form many of the

best irrigated farm lands of Utah. The great salt deserts west of Salt Lake are portions of this ancient lake that are dried up, and the thick layers of salt prevent all vegetation.

As the outlet river flowing northward cut its channel deeper, it drained out the lake and brought it to lower levels. Finally, the climate grew so dry that the evaporation was greater than the supply of water from rivers and rains, and the lake sank below the outlet and began to grow salt.

At the present time the lake water is 25 per cent salt, so that the fishes cannot live in it, and nothing but

FIG. 87.

Old beaches of the lake near Chambers Station. The uppermost beach was the highest point ever reached by the lake.

shrimps, seaweed, and insects are found in and on its waters. Swimming is easy as the body floats upon the heavy water. There are great bathing resorts near Salt Lake City, where it is said as many as two hundred thousand people come yearly to enjoy the salt sea-bathing.

The history of Pyramid and Winnemucca lakes in Nevada is similar to that of Salt Lake, and at one time it is supposed that the two large fresh-water lakes of Utah and Nevada were joined into one great inland sea.

The Sierra Nevada Range on the western limit of the Great Basin is a loftier mountain ridge than the Wasatch.

[illegible] winds from the [illegible] part of this moisture reaches the eastern [illegible] Nevada [illegible] fresh-water lakes and [illegible] into the deserts of Nevada, they are [illegible] brackish lakes or sinks.

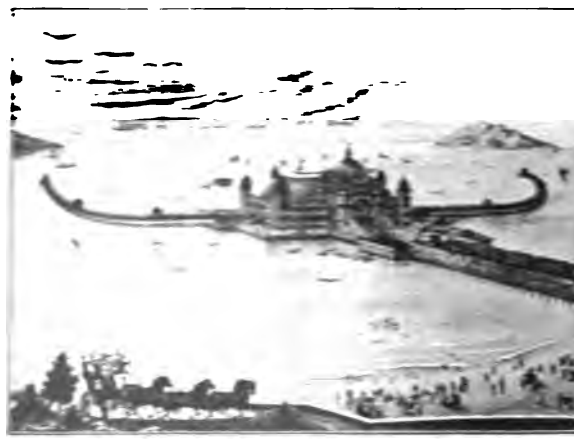

FIG. [illegible]

Saltair, the greatest bathing resort on the lake.

That part of the Great Basin which lies in southeastern California is the hot and blistering Mohave Desert.

In the later study of Europe, Asia, South America, and Africa, we shall meet with arid tracts or deserts which remind us strongly of the conditions in the Great Basin of Utah and Nevada.

A GOLD MINE IN CALIFORNIA

(The chief part of this topic was written by Miss Maud Valentine.)

In the fall of 1848 there was great excitement over California with its gold mines, and how soonest to get there was the ruling question. It was about the time of the closing of the Mexican War. California had just been ceded to the United States by Mexico. The gold fever was at its height. San Francisco at this time was a straggling village, chiefly of tents; a few wooden houses had been built, while three or four adobe structures told of Mexican occupation.

At this time the richest gold-producing region of California, or perhaps of the world, was in the Sierra Nevada Mountains on the Upper Sacramento, the San Joaquin, and the Klamath. At the time that California was ceded to the United States, one of the American settlers was Captain John Sutter, who had settled at the junction of the Sacramento and American rivers, near the present site of Sacramento, called then Sutter's Fort. This was an important location because it was at the head of navigation on the Sacramento, and the first station on the overland route across the Rocky Mountains. The place is now called Colona. Here Captain Sutter built a flour-mill to grind the wheat he raised. It also helped him to provide proper food for the number of travellers passing the fort. There was no good timber in the valley out of which to build his flour-mill, so he must go to the moun-

tains for it. To prepare it for building use he must have a sawmill. So he called on James W. Marshall, a skilful wheelwright, an industrious, generous, but queer man, one full of wild fancies, to select the site of the sawmill.

The place selected for the sawmill was forty-five miles from Sutter's Fort and connected with it by a wagon road. The mill was nearly finished, the dam made, but the mill-race, though dug, was found to be too small to carry off the water. So the channel was deepened, and in order to carry the loose dirt, the gates were opened and the water turned in and then turned off again. On Monday afternoon, January 24, 1848, Marshall was walking in the dry bed of the race to see if the water had washed it out to the required depth. He picked up some yellow particles, the largest of which was about the size of a grain of wheat. They were smooth, bright, and looked like brass. He thought they were gold, and told some of the men at the mill so, but they laughed at him. He hammered the metal, and found it could be made into a thin sheet. He put some in the kitchen fire, and found it did not readily melt or become discolored. He compared its color with that of gold coin, and felt certain it was gold. The next morning he again took the walk and collected about a spoonful of the particles, put them in the crown of his slouch hat, and thus carried them to the men at the sawmill. He took this a few days later to Sutter at Sutter's Fort. Here it was tested and pronounced gold. Work at the mill went on as usual for several months. There was no excitement. The laborers knew nothing of placer mining. Reports came of gold being discovered in other places in California. All at once the excitement

burst out and spread like wild-fire. About June, 1848, "Gold! Gold! was the topic in all this vicinity."

The news of the discovery spread from the little fort to the seacoast and to all the world. Captain Sutter's men deserted him to look for gold, next the Indians and the American settlers caught the fever. Miners from these new gold districts began to straggle into San Francisco with their pouches of gold-dust. The effect was wonderful. Towns were deserted. Students left their colleges, blacksmiths left their anvils, sailors their ships, lawyers their offices, even fields of grain ready for harvest were

FIG. 89.

Travelling to California in the Pioneer Days.

left to take care of themselves. From all parts of the world flocked men to dig gold; Mexicans, Yankees from New England, Chinamen, a few Indians, Frenchmen, Germans, Italians, Russians, and many outcasts of society, until there was a mixed population such as no other country could imitate. It was a ragged, dirty, unshaven, good-natured crowd. Three thousand miles lay between the old states and this land of gold, yet there were caravans everywhere for California; ships in every port for California. "Ho! for California," was the cry.

A miner's outfit consisted of a pair of serviceable shirts, a change of trousers, strong cowhide boots, buckskin

gauntleted gloves, slouch hat, and a pair of woollen blankets strapped on his shoulders. In his belt he carried a couple of revolvers and a bowie-knife, and on his back was slung his rifle. By the time he reached his destination he had in his outfit frying-pans, a coffee-pot, a small iron kettle, tin cups, plates, a knife, fork, and spoon. A tent was a good thing to have, but he could get along without it, as there is no fear of rain from May to October in California. A rubber blanket spread over boughs and on this his woollen blankets formed his bed. He also had a supply of bacon, flour, salt, saleratus, beans, and a few candles. His bill of fare did not vary much for breakfast, dinner, or supper. The tools he needed for his work were few and inexpensive. All that was needed to get the gold was to wash it out of the gravel. This could be done easily, for gold is many times heavier than water. The gravel was placed in a pan with water and shaken around vigorously; the gold quickly settled to the bottom, and the gravel was poured off with the water. A few washings would leave the gold clean. A pick, pan, shovel, dipper, and bucket were all the tools needed. If the gravel paid 25 cents a pan, a miner would make $15 a day; often he made much more than this.

The first thing to be done upon reaching the gold district was to look around for a *claim* or to begin to *prospect*. To prospect was to find a spot that looked favorable and make an examination of it. The miner would take a pan of earth, shake and whirl it under water, raise and tip it frequently to run the dirt and water off, then plunge it in again, and so continue until a small amount of blacks and gold remained. A speck of gold was the "color," several specks were "several colors," and the number and size de-

termined the miner whether he should go to work or move on. At first each miner occupied all the ground he desired. Later a law was made limiting claims to a certain size. This varied in different camps, and depended somewhat upon the richness of the earth. Generally a miner was restricted to fifteen feet front on the river. Leaving mining tools on a claim in the absence of a claimant was sufficient to hold the claim for ten days. The deposits of gold were on land belonging to the national government which, without charge, supervision, or permit, allowed every citizen to take all the gold from any claim held in accordance with the local regulations adopted by the miners of his district.

The first impression on seeing a miner at work is not pleasant. He is a rough, dirty-looking man in a dry ravine. The banks are almost as high as his shoulders. A double-barrelled shot-gun lies on the edge of the bank within easy reach. He is picking up dry clay and gravel from the bottom of the ravine, pulverizing it in his pan with a stone, and then shaking it about until the light particles come to the top. These he brushes over the rim. The pulverizing and shaking continue until a small quantity of dust and gold are left in the bottom. The dust is blown out with the breath. This is called "dry washing."

Two miners usually worked together as partners. The simplest way of washing gold-bearing earth was with the pan. A rocker was procured as soon as it could be afforded. It was the most expensive tool of the miner, though simple in construction, costing from $50 to $100. In general appearance it was not unlike a baby's cradle, such as our grandmothers used. It had a flat bottom, two sides that flared outward and one end board at the head, while the foot was open, save a riffle about one and a half inches

high at the bottom to catch the gold that might pass, another riffle across the bottom near the middle. At the head of the cradle or rocker was a hopper about eighteen inches square, with a perforated sheet-iron bottom or a bottom made of wire screen. Under this was a board sloping downwards toward the head. Two strong, substantial rockers under the whole completed the simple machine.

This is the way the two partners worked. Two sticks of wood hewn on the upper side were embedded at the river's brink, one four inches lower than the other, on which the rockers were to rest, thus securing a grade in the machine to facilitate the outward flow of the sand and water. One shovelled the earth into the hopper of the rocker, while the other, seated on a big rock or a block of wood, dipped the water from the river and poured it upon the earth in the hopper with one hand, all the time rocking with the other. When the earth was thoroughly washed, he rose, lifted the hopper from its place, threw out the stones and gravel, and replaced it. Thus the work went on. At noon the gold and black sand collected above the riffles were taken up on a scraper and thrown into a pan, which was carried to the river and carefully washed to remove, as far as possible, all but the gold. When ground was very rich, the rocker was cleaned of gold every hour or two. The yield of the forenoon was carried to the camp, dried over the blaze, the dry sand being blown out with the breath, the gold weighed in scales or guessed at, then poured into the partnership purse and deposited under the bed or elsewhere out of sight. Gold was seldom stolen, for a theft was so severely dealt with that one seldom occurred.

The first gold washing was on the bars of the rivers, and at first only two or three feet of gravel covered the gold. That taken from the river bars was mostly in the form of scales resembling cucumber seeds, and of varying size. It was most plentiful on the bed-rock or in a few inches of soil above it. Gravel was rich if it paid 25 cents a pan. A man could dig and wash fifty or sixty pans a day. With a rocker he could do three times as much. The richest gravel was on the Bear, the Yuba, and the American rivers, and a pan often yielded from $1 to $5.

When the rainy season began in the winter 1848, and the rivers rose and covered the bars, the miners were driven back into the ravines and mountains. The deposits here were almost as rich as in the bars. Often a man could take out several hundreds or even a thousand dollars a day. It was not uncommon to hear on good authority that a miner had taken out $1000 in a day, or even $5000. In 1848 the miners usually got $16 a day, and if a claim did not yield so much, it was not worth working.

When the work of the day was over, around the supper fire the events of the day were discussed, earnings compared, reports made of grizzly bears or deer being seen or killed, or of better diggings of gold discovered. "Coarse gold," that is, gold found in lumps, was a charm to the ordinary miner. His claim might be paying him an ounce a day in fine gold — an ounce is reckoned at $16 — but he was always interested in some reported diggings far away, where the product was in lumps. Not infrequently he left a good mine to seek some richer El Dorado. The besetting fault of the early miner was unrest. He was forever seeking better fortune.

The homes of the miners were varied indeed. Many of

them lived in cabins or shanties made of boards and pine boughs, in log huts, in Indian skin-lodges, but most of them lived in common soldiers' tents about eight feet square the entire winter. The weather at no time is very cold in California. February is much like our May. They often kept warm by building a huge fireplace in front of the tent that sent through the thin cotton dwelling a warm glow.

During the winter of 1849–1850 the cost of living was extreme. Flour reached $1 a pound, or $50 a barrel, rice the same, pork and bacon $1.60 a pound, saleratus $16 a pound, and candles $1 each. A pair of long-legged boots cost $100, and expressage for a letter $4. An ounce of gold ($16) was the price of a pick or shovel, a common spade cost $10. A miner carried a leather pouch and balance, and when making purchases, weighed out the necessary amount of gold to pay the bill.

That all miners did not get rich might be accounted for by the fact that it took a fair claim to pay expenses, the short duration of a placer claim, the loss of time in finding another, and the too general restlessness. Gambling or the excessive use of whiskey told the story of many failures to realize a fortune.

The "long tom" came into use early as the successor of the rocker. It was a trough of boards ten or twelve feet long, two feet wide at the bottom, with sides eight or ten inches high, and was furnished with a perforated sheet-iron plate three feet long, which had the end part curved upward to catch the stones and gravel, while the water, sand, and small gravel dropped through it into a riffle-box below, set on an incline to allow the lighter matter to pass off with the water ; the long tom was put on an easy grade and supplied with a constant stream of flowing water, enough

to drive and wash all the earth thrown into it down upon the perforated screen. Two or more men shovelled the earth into the tom and one threw out the stones from the screen with a fork or square-pointed shovel, when they were sufficiently washed. As the claim was worked back, the long tom was extended by means of sluice-boxes until a dozen or more miners were shovelling dirt into them on both sides. Afterwards it was found that by putting riffles into the sluice-boxes, the long tom could be dispensed with, and miles of sluices of all sizes were seen, some supplied with a few inches of running water, while others bore torrents of the muddy fluid.

The sluice requiring a rapid flow of water was set on a grade of say four inches to twelve feet in length. It is plain to see that in a short distance the pay dirt would have to be lifted higher than the miner's head. Sometimes the earth was thrown by one set of miners up on a platform, to be shovelled by another set into the sluice. Numerous small boulders were kept in the sluice, around and over which the water boiled and leaped, dissolving the clay. When the gold was fine and difficult to save, quicksilver was poured into the sluices to catch it. Quicksilver will dissolve gold as readily as water dissolves sugar. From the compound thus formed, which is called amalgam, the quicksilver can easily be removed by distillation.

More and more, water was made to do the work of the miner. Instead of carrying the dirt in buckets to the river to be washed, the river was carried to the dirt. By canals from rivers the water was carried at great expense to a gold-bearing bank of gravel in some mountain gorge. It found its way through strong iron tubing or hose, and

large quantities were forced through nozzles and thrown with terrific force against the banks of the gold-bearing gravel. Ditches dug in the earth at a moderate grade, or sluices of lumber, caught the gravel as it came tumbling down, and separated the gold, leaving it on the bottom. A steady throw of water against a bank was kept up

FIG. 90.

Washing gold from gravel beds in California by means of hydraulic mining.

for days, even months, without stopping night or day. Three men working a strong jet of water can wear down a hill faster than a hundred men could with shovels. Sometimes the stones and gravel of the hillside are loosened by blasting before the stream of water is turned on. Such a stream turned on a gravel bank will hollow great caves in it, causing tons of earth and gravel to fall every few minutes into the sluice beneath. This water-

jet method is called hydraulic mining, and was introduced in California in 1852. The expense of building dams and flumes, and in laying water-mains to the gold-bearing gravel banks was great, so that large capital was necessary in this mode of mining.

A second more difficult and expensive mode of mining is that of digging the crude ore out of the veins of metal

FIG. 91.
The timbering of a mine.

which lie embedded between rock layers of solid quartz. A hole is dug which runs down slanting into the side of the mountain, following the vein of ore. After the sands of the river bottoms had been washed out by placer mining, these rich, gold-bearing veins were searched out by prospectors, and, where found, deep shafts were sunk. This required engines and hoisting machinery, tools and blasting materials, curbing and wooden supports for the shaft sand galleries, so that it was very expensive, and only capitalists could afford to develop a mine, even if it was known to contain good ore.

The ore in these veins is also mixed with other metals, as silver, lead, and copper, as well as with rock and dirt. After it is taken from the mine it is usually carried to a stamp mill near by, where it is crushed to powder, then put in sacks and shipped to some larger town, where there is a great smelter for melting and separating the different ores, rock, etc.

This is now the common method of mining from Colorado to California, and from New Mexico to Idaho

FIG. 92.
Miners at work underground.

and Montana. As one travels through the mountain valleys, one often sees far up on the slopes of the mountain side the entrance to one of these mines, with the piles of rock and dirt at its mouth. In the valley below he may hear the thump of the stamp mills where the ore is being crushed.

As the shaft is sunk into the mountain, galleries are run out on either side, and occasionally a tunnel is dug from the lower end of the mine to the bottom of the valley on the same level. In some of the rich, productive

mines, like the Comstock of Virginia City, Nevada, and in the silver mines of Leadville and in the copper mines of Butte, Montana, the shafts are sunk miles into the earth, with a great network of galleries many miles in extent. In the Comstock lode the heat of the earth was so great in the lower depths that the work had to be abandoned. Some of the richest mining districts are Leadville, ten thousand feet above the sea, Cripple Creek near Pike's Peak, Butte, Montana, Tucson, Arizona, the region near

FIG. 93.
A Smelter at Great Falls, Montana.

Salt Lake City, and parts of Idaho, New Mexico, and California.

The great smelters are usually located at those cities where large quantities of ore can be easily collected, as at Pueblo, Denver, Great Falls, Butte, and Leadville.

In the production of gold and silver Colorado stands first, with nineteen millions of gold and nearly twenty-eight millions of dollars' worth of silver in a year. Montana and California are second.

The results of the discovery of gold in California were remarkable. There was such a rush of new settlers that in 1850 California was admitted as a state. Roads were opened up across the mountains, and the other mountain

THE SALMON FISHERIES OF THE COLUMBIA

THE fresh and canned salmon often found on our tables come from the Columbia River and other streams

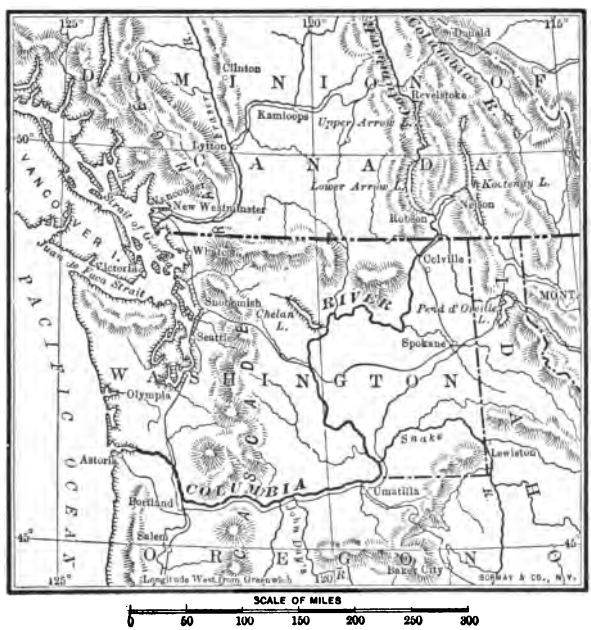

FIG. 95.

The Columbia River.

of the northwest. From the mouth of the Columbia for many miles up the broad river the salmon fisheries are

numerous, and the number of men and amount of capital employed in the business great.

Astoria, at the mouth of the river, once famous as the centre of the fur trade, is now of chief importance as a fishing town. Large quantities of newly caught salmon are brought in by boats to this point and either put in cold storage or run through the big canneries.

The fishing business is based upon the peculiar habits and life history of the salmon, which must be first understood.

The salmon passes part of its life in the fresh waters of rivers and part in the salt waters of the ocean along the western coasts. Far up among the creeks and brooks that form the head waters of the Columbia, a thousand miles or more from the river's mouth, the little salmon eggs hatch out and the tiny fish live for a while in the icy waters that come down from the snows in the mountains. As they grow a few months older they drift down the river with the current, feeding and growing larger as they descend, till after some months they reach the brackish waters at the mouth of the river. After getting accustomed to the salt water, they venture out into the ocean, where they make their home for three or four years not far from the coast and near the river mouths. Here the salmon steadily grows to a powerful fish, weighing about forty pounds. Sometimes the largest specimens weigh eighty or ninety pounds.

In July or August, when about four years old and in prime condition, the salmon start up the river again to their birthplace at the foot of the mountains. If they escape the nets and traps of the fisherman, they boldly push against the current, leap the rapids and falls, and,

without stopping to eat, ascend the upper Columbia till they reach some smaller stream.

"Here the males and females, much wasted in flesh from their fasting, pair off, and in some brawling stream, near a lake by preference, they dig a nest, using heads, tails, and fins with almost human intelligence. The male by this time has developed a formidable hooked beak, with which he fights savagely for the rights of his home. Here the eggs are laid, from one to six thousand to each fish. Carried down-stream by the swift water, a large proportion are lost, many being seized as rare tidbits by waiting trout. But a few drop among the loose stones at the lower edge of the nest, where they are protected in holes and crevices until hatching time."

In a few months the eggs hatch out and the little salmon soon begin their journey down the river to the sea.

During July and August, when thousands and tens of thousands of salmon swarm up the river, the fishermen are in wait for them with traps, nets, water-wheels, and even with spears in Indian fashion, to capture as many as possible. All along the lower Columbia the fishing stations are numerous, and above the falls in the narrower part of the river there are many fishermen at work. Even in early days when Lewis and Clark made their great exploring trip down the Columbia, the Indians lived chiefly upon the salmon which they caught and cured in large quantities.

Since 1876 the salmon fisheries of the Columbia have grown to great importance, and the product is worth many millions of dollars.

There are several interesting modes of taking the fish

as they make their runs up the stream. One of the most successful of these is by the use of the trap.

In the shallow waters where piles can be driven down in a row, a strong netting is stretched along these piles and reaching from the bottom of the river above the surface, its upper end being farther up the stream and terminating in a circular trap, that is, a circle of piles, about twenty feet in diameter and also enclosed in a net. A second circular net inside the piling can be raised and lowered. As the fish ascend the river against the current, they come against the long netting stretched upon the piling, and nosing along this toward the side which is higher up the stream they enter the door of the trap. When there is a good run of fish they sometimes pile up so thick as to completely fill the net. Fishermen in a small boat then enter the net and gather in the fish.

Much fishing is also done by seining in the shallow places near the shore. When the tide is high the long seines are stretched across the shallow places and at ebb tide are drawn in by men and horses, wading in the waters. Sometimes they get a rich haul of fish to be sent to the canneries.

In the main current of the river the fishing is done mostly by gill-nets. A gill-net is a quarter of a mile in length and is stretched across the current, its lower edge sunk thirty feet or more into the water by weights. This huge net floats down the river with the current and returns again with the incoming tide, the fishermen attending and watching it in boats. The fish ascending the river run their noses through the meshes of the net and are caught by the gills. The disturbance of the net shows when a big salmon is caught and the fisherman

comes, lifts the net, and brings him flopping into the boat. Sometimes the fishermen follow their nets a whole day and more without catching a salmon, and again when the run is good they may take hundreds. There is much danger that a steamer or tug ascending the river will run across one of the nets and tear it to pieces or carry it away, causing great loss to the fishermen. The weather is often stormy and foggy, and where the river meets the swell of the ocean, boats are often lost and fishermen drowned.

FIG. 96.
A fishing wheel on the Columbia River.

Still another method of fishing is common along the narrower parts of the upper Columbia. A great water wheel is attached to a flat-boat or at the end of a wooden pier built out into the river. The current of the river, striking the paddles of the big wheel, send it whirling. Three large nets are attached to this wheel, and the salmon ascending the river are caught in these nets, lifted out of the water and thrown by the revolving wheel into a trough by which they slide into the hold of a large boat. The fisherman needs only to keep his wheel in

working order as the current of the river does all the work.

Many salmon are also taken by dip-nets and by spearing. As the salmon, therefore, starts on his long journey up the river he has many dangers to encounter and many hair-breadth escapes before he reaches the cold waters of his early home.

At Astoria the river is nine miles wide, and the broad expanse is frequented during the fishing season with many boats. At the mouth of the river, ten miles away, the

FIG. 97.

Catching salmon in dip-nets as they leap over the falls on their way to the waters where they spawn.

shallows are thickly set with the stakes and piles of the fishing traps. All along the lower Columbia, at intervals, are the large canneries where the fish are received and prepared for the markets of the world.

The work of catching the salmon by the different methods described above is in the hands of white men and Indians. The Portuguese, Scandinavians, Italians, and other Europeans, as well as Americans, carry on this work and deliver the fresh fish at the canneries or to large boats sent out to receive them. The canneries are owned by capitalists who can afford the money necessary for carry-

ing on a large business. But the labor of cleaning, canning, and storing the fish is in the hands of Chinamen, who are very expert. "The Chinese are vastly superior to white labor in these monotonous, machine-tending operations. All day the season through they will work swiftly, steadily, untiringly at some minute detail of the work. Owing to the exclusion laws, the Chinese who are already in the country are becoming labor aristocrats, with well-organized unions and a very distinct knowledge of their own indispensability in the canning industry."

The notes here presented on the present methods of salmon canning were taken in 1896 at a cannery on the Columbia River, and with few exceptions represent the canneries of the entire west coast.

The buildings connected with a salmon cannery are always built at the water's edge or partly over the water, so that vessels or boats may come alongside and deliver their fish and supplies or receive the packed products. As a rule they are large, roomy, one-story frame structures, the business of receiving, cooking, and packing of salmon all being in the one large, high, and well-lighted room. The lofts are used for the storage of empty packing-cases, empty cans, nets, etc., and in some instances large rooms are there used for the manufacture of cans. Adjacent to the cannery are the rude quarters in which the Chinese employees live, and near by is usually the home of the superintendent.

Chinese have a monopoly in the canning of salmon, but never engage in their capture. Before the season opens contracts are made with some large Chinese firm of San Francisco or Portland to do the work so far as relates to

receiving raw products and turning the same over canned, packed, and ready for shipment.

As a rule the fish are bought from the fishermen at so much a piece or per pound, a stipulated price for the season having previously been agreed on; but in some cases the fishermen are hired by the month, with or without board, the fishing boats and nets, in that event, being furnished by the cannery.

Contracts with the Chinese usually call for the packing of at least a certain number of cases, of 48 pounds each, at prices ranging from 30 to 40 cents a case for one-pound cans, and higher for half-pound, oval, or other special cans.

A working gang of from thirty to seventy-five Chinese, in charge of a native expert foreman, is sent to the cannery in advance of the opening of the season. The men are constantly under the orders of the Chinese foreman, and he in turn is under the supervision of the superintendent. The foreman divides up the duties, assigning a gang for each part of the work from the time the fish are landed until they are cased for shipment. These gangs follow their particular part of the work all through the season, only in exceptional cases being called to any branch except their own. The receiving and dressing gang, being the first to begin, are the first to finish their labor, while the packers are the last to begin and end the work of the day. If fish are plentiful, all of the men work from about 7 A.M. to 6 P.M., with only a stop for the midday meal. If salmon are scarce, the men may have but a few hours' work.

On the completion of the work of any gang, the men must, before leaving, thoroughly clean their section; in doing so a hose is used, with abundance of water, brooms,

and scrubbing-brushes; and when the day's work is over the interior, platforms, and wharves are left scrupulously clean and ready for the work of the following day.

As the fishermen arrive, their catch is thrown out on the wharf, where it is received by the Chinese and carried inside the cannery and thrown into boxes on the scales. Having been weighed, a receipt is given to the fishermen, and the fish begin their journey through the cannery, that

FIG. 98.

Hundreds of salmon in a cannery.

only ends after they have been canned, cooked, packed, and cased ready for shipment.

After the weighing scales the fish are thrown out on the floor and receive their first washing from a stream of water that is played on them from a hose, the fish being turned over with a pitchfork, as may be necessary, to remove all gurry and dirt. In some instances, where fish are received faster than they can be immediately handled, they are kept cool and fresh by having, as needed, a fine spray of ice-cold water thrown over them from an overhead revolving pipe. The first gang receive the fish on the dressing-tables, which are near the door. Here the first of the

work begins, and to follow it through from its entrance to its exit, canned and cased, is an interesting sight to thousands of visitors during the packing season. The first operator seizes fish after fish, and with a few quick strokes of a large butcher-knife severs head, fins, and tail. The next man opens the fish, removes the viscera, and scrapes the carcass inside and out. Through an opening in the floor all offal and waste are at once thrown into the river and quickly consumed by schools of scavenger fish or the large number of gulls that hover in the vicinity waiting for their food. At some of the canneries near Astoria receptacles for waste are provided by those interested in oil and fertilizer factories.

The fish is then shoved along to the man standing by the side of the header and cleaner for the next washing, and at the same time is scraped with a knife that removes the scales. The fish is then passed along into a second tank of clear water, where it receives its final washing and cleaning and is made ready for cutting into proper-sized pieces. A series of semicircular knife-blades is attached to a roller, the blades being equal distances apart, corresponding with the size or depth of cans to be filled; one end of the roller is hinged, to the other end a handle is attached. The knives are raised by means of the handle, the fish is placed under them, and with one quick, sharp blow the fish is entirely cut up into lengths suitable for canning. For one-pound tall cans, seven knives are attached to the roller; for one-pound flat cans, thirteen knives; for one-half-pound cans, seventeen knives. The fish are now in suitable lengths, but must be sliced into sizes proper to enter the cans; this is quickly performed, and the pieces are passed on to the filling gang.

Several men stand at one or both sides of the filling-table, each supplied with small scales adjusted to the weight of the cans to be filled. In some canneries cans are filled by machinery, but this is usually done by hand. As soon as filled the can is placed on the scale; if it shows full or over weight, it is passed on, no fish being removed; but if short weight, the can is put to one side, to receive enough to make up the deficiency.

The cans are passed on to a machine, which fits a top and solders it on, leaving a small vent-hole for air to escape. After being tested for leaks, the cans are brought into large retorts for cooking.

The retorts are made of wood or iron, but are usually of boiler iron, have a round shape, and are about thirteen feet long and five feet in diameter. A steam-pipe extends along near the bottom. This is perforated for the escape of steam, which passes through a small amount of water with which the pipe is covered. On an iron track just over the pipes the loaded cars are run. Retorts usually have an opening, or door, at only one end; but in the cannery now being described there was an opening at each end and two retorts were used, the few feet separating them being connected by a track by which cars of coolers, which pass through the first retort, enter the second. Each retort has a capacity of four cars, or 3200 one-pound tall cans or 2952 one-pound flat cans. Cans of salmon remain in the first retort under a steam temperature of 230° for one hour. They are then run out, vented, and at once resealed. As the top of each can is perforated with a small, sharp-pointed iron, the heated air or steam is expelled, and before its place can be taken with cold air the vent is closed by a drop of

solder, and the can may be said to be free of air and air-tight. The cans are now ready for another cooking in the second retort. Here the temperature is 240°, in which one-pound tall cans remain one hour and flat cans one and one-fourth hours. Retorts are under a steam pressure of seven to ten pounds to the square inch.

On removing the cans from the retorts, they have a stream of cold water thrown on them, by which they are cooled and cleaned. They are now finally tested for leaks or imperfections by tapping each can on the top with a small piece of iron, an experienced ear quickly detecting by sound any imperfection. Imperfect cans are replaced by others, and the cans pass on to be lacquered, labelled, and packed in boxes, each holding forty-eight one-pound cans or twenty-four two-pound cans. They are then ready for a distribution that reaches almost every portion of the civilized globe.

The cannery at which these notes were taken was provided with electric lights and ample steam power; the rooms were well ventilated and lighted; its walls were white with paint or whitewash. It is located on the Columbia River with the Cascade range of mountains towering from fifteen hundred to twenty-five hundred feet just at its back. From these mountains the icy-cold and very pure water used at the cannery is brought.

The salmon fisheries along the Columbia River have grown so rapidly since 1876, such vast numbers have been caught and canned, that there has been danger of exterminating this most useful species. Not only has the increase of fishermen's nets and traps made it difficult for the fish to reach the spawning-grounds, but the upper

streams and spawning-grounds themselves have been interfered with by dams and irrigating ditches.

To protect the fishes from all these dangers and to preserve this great industry, it has been necessary for the governments of the Pacific states to pass laws. "The authorities of Oregon and Washington are much alive to the importance of this growing industry, and have appointed fish wardens to execute the laws which control and restrict the taking of fish, the size of the nets, the distance between nets, and the definite seasons set for fishing; the object of these laws being to permit enough fish to pass up the streams every year to maintain the spawning supply and yet to allow as large a number as possible to be taken."

The beneficial influence of the government is also seen in another way. The habits of the salmon have been carefully studied by scientific experts sent out by the governments of the western states and of the United States. In many of the streams which form the head waters of the Columbia, fish hatcheries have been established. "At the various stations the native salmon are caught in large numbers, artificially spawned, and the eggs are hatched under conditions which prevent the large losses of the natural spawning beds and of the young fry after hatching. As soon as the young are capable of caring for themselves, they are 'planted' in the rivers and begin their journey to the sea. Millions of fry are thus distributed each year, thereby maintaining to a remarkable degree the fertility of the waters. The product of the different salmon hatcheries tributary to the Columbia River alone, including two maintained by the United States government, four by Oregon, and six by Wash-

ington, amounted in 1901 to over fifty-eight million fry" (*Century Magazine*, June, 1903).

The salmon fisheries are important not only along the Columbia River, but even more so in Puget Sound (partly in British America) and in Alaska. The largest quantity canned and shipped is from Alaskan waters. All the streams flowing to the ocean from Alaska to San Francisco are important for salmon fisheries, though the product of the California rivers is relatively small. "About four-fifths of the entire catch (1901) was in American waters, one-fifth in Canadian, the annual product now being worth $20,000,000."

Fresh salmon are shipped in large quantities to the eastern states, and even to London and other European cities. The canned salmon from the northwest are now found in all parts of the world.

A comparison of the salmon fisheries with the cod fisheries of Gloucester and New England, previously studied, will awaken considerable interest.

REFERENCES: *The Century*, June, 1903. "Science Sketches" (Jordan). *Country Life in America*, June, 1903. United States Fish Commissioner's Reports, Vol. 104, No. 692 for 1899, pp. 264–292.

FIG. 99.

Map to show the location of San Francisco, Portland, Tacoma, and Seattle.

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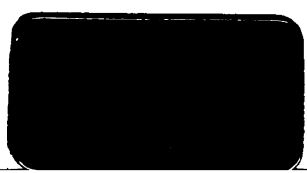
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